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ABSTRACT

This report focuses on standards for the teaching and learning of algebra in the state of Mississippi. It contains sections on interpreting the Mississippi subject area score reports, an overview of the Mississippi Algebra I curriculum, suggested test strategies, and additional teaching and learning strategies with sample assessment items. (DDR)

Instructional Intervention Guide

Algebra I

2001

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Table of Contents

Introduction....3

Section I
Interpreting the Mississippi Subject Area Score Reports

Assessment Strands.... 6
Mississippi SATP Student Report.... 6
Mississippi SATP Class Performance Report....8
Mississippi SATP Student Roster and Summary.... 9

Section II
Overview of the Mississippi Algebra I Curriculum

Organization of the Mississippi Mathematics Framework.... 11
Suggested Curriculum Guide.... 12
Algebra I Teacher Survey.... 13
Subject Area Test Blueprint - Algebra I.... 15
Correlation of Blueprint and Framework.... 16
Mississippi Algebra I Framework.... 18

Section III
Suggested Testing Strategies

Multiple-Choice Items.... 31
Open-Ended Items.... 34
Mississippi SATP Algebra I Rubric for Open-Ended Items.... 37

Section IV
Additional Strategies and Sample Assessment Items

Additional Teaching Strategies.... 39
Samples of Algebra I Test Items.... 58

Section V
Mathematics Teaching and Learning Strategies

Process Strands Activities.... 71
Process Strands Description.... 74
Seven Considerations for a Standards-based Lesson.... 75
Mathematics and Writing - Making the Connection....76
Graphic Organizers.... 79

Appendices

A - Glossary of Terms.... 83
B - Suggested Internet Resources.... 85

Introduction

The Algebra I course provides opportunities for students to develop and communicate an understanding of algebraic representation as a prerequisite to all higher mathematics courses. Competencies identified in this course combine the content strands of patterns/algebraic thinking, data analysis/prediction, measurement, geometric concepts, and number sense with the process strands of problem solving/reasoning, estimating, incorporating technology, communicating and making connections/applications. Concepts covered in this course include real numbers and their properties, functions, algebraic expressions, linear equations and inequalities, systems of equations and inequalities, graphing polynomials, formulas, slope, data analysis and probability. Expectations for Algebra I students include understanding patterns, relations and functions, representing and analyzing mathematical situations and structures using algebraic symbols, using mathematical models to represent and understand quantitative relationships, and analyzing change in various contexts. This one-credit course is designed to prepare students for Geometry and/or Algebra II.

Problem solving/reasoning is an essential strand of the Algebra I course. Activities in this course will allow students to build new mathematical knowledge through algebraic problem solving, solve problems that arise in mathematics and in other contexts, apply and adapt a variety of appropriate strategies to solve problems, and monitor and reflect on the process of algebraic problem solving. Through these activities, students will recognize reasoning and proof as fundamental aspects of mathematics, make and investigate mathematical conjectures, develop and evaluate mathematical arguments and proofs, and use various types of reasoning and proof.

Technology is essential in teaching and learning mathematics, and incorporating technology is an important process strand embedded in the Algebra I course. The use of graphing calculators is an integral part of this course, both as a tool in conceptual development as well as to promote efficiency in problem solving. The use of computer programs that focus on algebra concepts as well as connections involving Internet Resources are also encouraged.

Communication, both oral and written, is also a vital part of the Algebra I course. It is through communication that students will organize and consolidate their algebraic thinking. It is necessary that they be able to communicate their mathematical thinking coherently using the language of algebra to express mathematical ideas precisely. They will also use communication to analyze and evaluate the mathematical thinking of others.

The Algebra I course will also help students make numerous connections and applications. Students will recognize and use connections between algebra and other mathematical ideas, understand how these mathematical ideas interconnect, and build on one another to produce a coherent whole. They will apply algebraic concepts in real-life contexts as well as in other disciplines.

Algebra I students will use estimation to determine the reasonableness of answers and predict outcomes. They will develop, apply, and explain a variety of appropriate estimation strategies in problem situations. They will become proficient in recognizing when estimation is appropriate and the usefulness of an estimate, as well as the limitations of estimation and assessing the amount of error resulting from estimation.

This document was designed and developed to supplement the *Mississippi Mathematics 2000 Framework* and the Subject Area Testing Program (SATP) Teacher's Guide. This **Intervention Guide** is designed to help the teacher assess the deficiencies of the student *by assessment strand* as reported in the **SATP Student Report.** The student report is explained in steps to help give the individual teacher, counselor, or administrator, a means to determine and develop a clear assessment of the student's performance.

In addition, the Intervention Guide also gives a clear overview of how to use the current *Mississippi Mathematics 2000 Framework.* Although the Framework provides numerous teaching strategies in its curriculum guide, additional strategies with more comprehensive explanations and sample assessment questions are provided. Teachers should note that many questions will require students to use their knowledge and apply their skills to solve practical, "real world" problems. These questions, called enhanced multiple choice, will be explained in the section of this guide labeled ***Suggested Testing Strategies.***

Because the Algebra I Subject Area Test is a performance-based test, it is essential that teachers not only communicate basic content knowledge, but also instruct students in how to process and manipulate information. In addition, students should possess the skills needed to read and interpret graphs, tables, diagrams, etc., to help them draw a conclusion about a topic or question. Instruction should go beyond the traditional use of a singular textbook and worksheets, but rather use a wealth of related materials including technology resources to convey information and skills to all students.

Section I

Interpreting the Mississippi Subject Area Score Reports

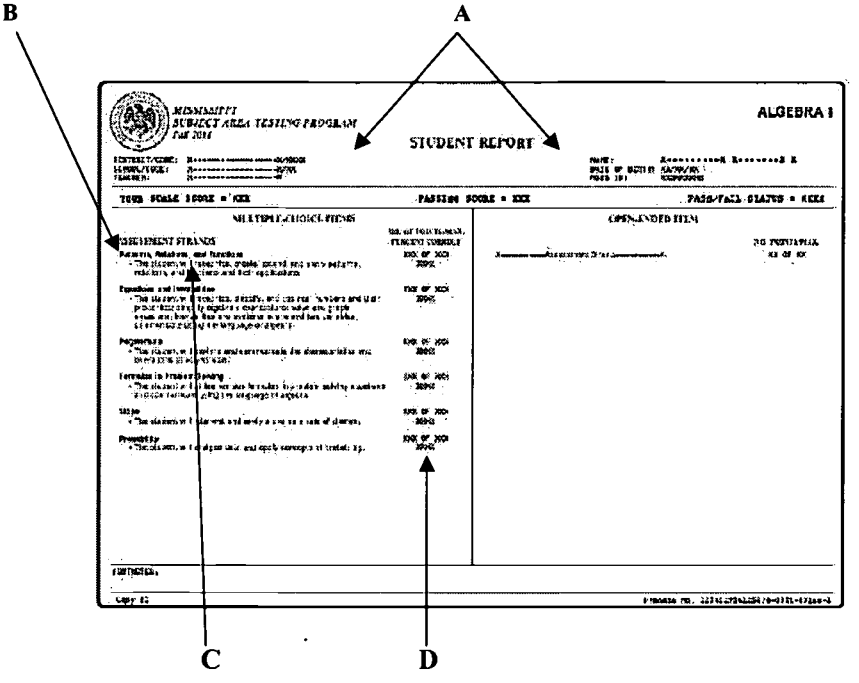
Assessment Strands

The Mississippi Subject Area Test Student Report contains information on a student's performance on the Algebra I Subject Area Test. The report is broken down into the five assessed areas of :

1. **Numbers and Number Sense**
2. **Equations and Inequalities**
3. **Polynomials**
4. **Problem solving**
5. **Slope**
6. **Probability**

Mississippi Subject Area Testing Program Student Report

a. The item marked "**A**" identifies the information relevant to the district, school, teacher, and student.
b. The item marked "**B**" identifies the assessment strand.
c. The item marked "**C**" identifies the competencies tested in each assessment strand.
d. The item marked "**D**" identifies the number of questions answered correctly, the number of questions pertaining to the assessment strand, and the percentage of correct responses in that assessment strand.



Student Performance Information

Refer to the Student Report diagram below.

a. There are three numbers next to each assessment strand.
b. The first set of numbers, "B", is the number of questions the student answered correctly.
c. The second set, "C", is the number of questions that were on the test related to that strand. These numbers are found in the TEST BLUEPRINT.
d. The last set of numbers, "D", is the percent of correct student responses for that strand.

Student Report Diagram:

MULTIPLE-CHOICE ITEMS

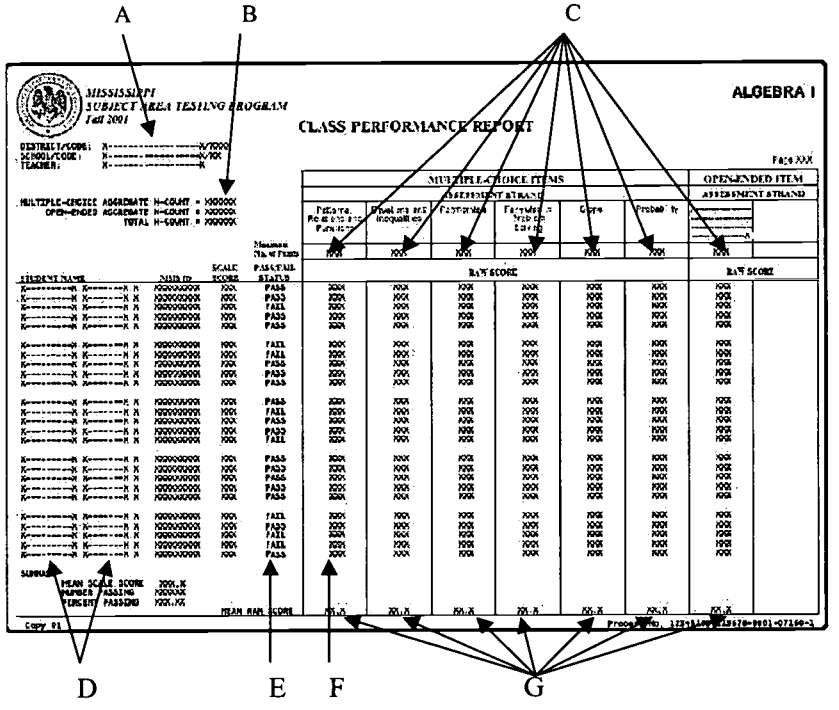
ASSESSMENT STRANDS	NO. OF POINTS/MAX PERCENT CORRECT
Equations and Inequalities The student will recognize, classify, and use real numbers and their properties; simplify algebraic expressions; solve and graph equations, inequalities, and systems in one and two variables; and communicate using the language of algebra.	12 of 18 66.7 B D C

While test score reports provide scaled scores for each of the strands, it is the performance on the overall test that is of primary importance. Scores specifically reported by assessment strand are provided in order to give students, teachers, and administrators an idea of the student's relative strengths and weaknesses. It is important to remember that while the overall difficulty of the tests remains the same from one version of the test to the next, the difficulty in a particular strand may vary.

Class Performance Report

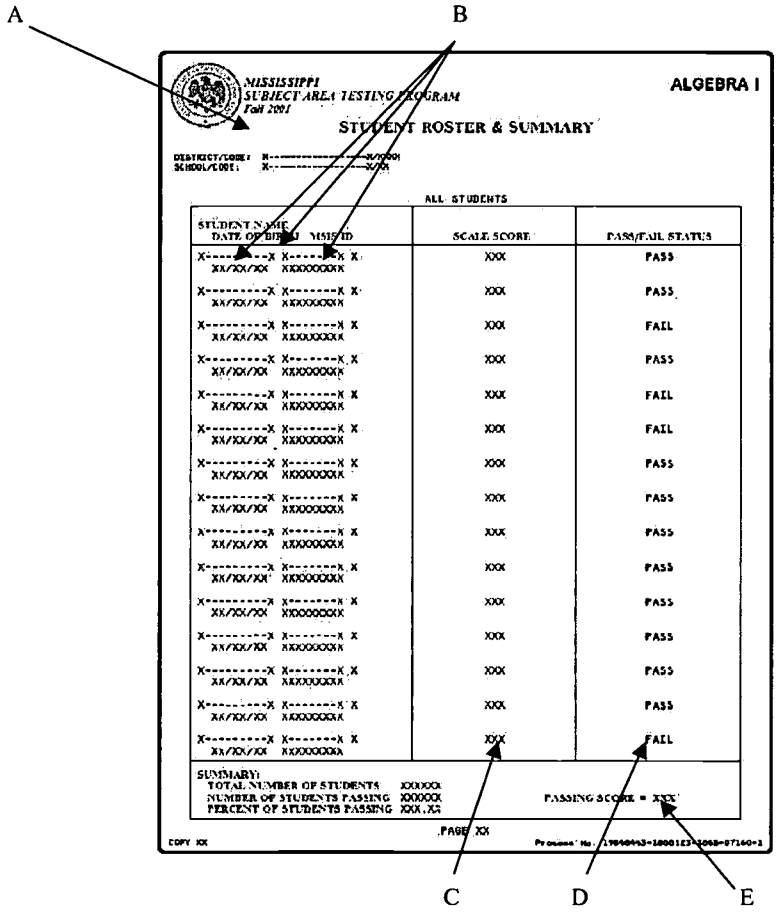
1. The item marked as **"A"** identifies the information relevant to the district and school.
2. The section labeled as **"B"** gives the total number of students who received **scores**.
   a. Multiple choice questions
   b. Constructed response questions

   The total number given, is the total number of questions scored in both categories.
3. The section labeled as **"C"** identifies the total number of points possible in each assessment strand as well as the total number possible in the open ended question strand.
4. The section labeled as **"D"** gives the list of the students taking the test by last name, first name, and middle initial.
5. The column labeled as **"E"** gives each student's status on the Subject Area Test in terms of their passing or failing.
6. The columns such as the one labeled as **"F"** provide the number of points each student received in each assessment strand.
7. The numbers at the bottom of each assessment strand column labeled as "**G**" is the *mean raw score*, or an average number of correct responses, in a given strand.



Student Roster and Summary

1. The section labeled **"A"** identifies information relevant to the district, school, and teacher.
2. The section labeled as **"B"** gives the list of students who have taken the test and lists them by:
   a. Last name, first name, and middle initial
   b. Date of birth
   c. Mississippi student information system number
3. The column labeled as **"C"** lists the scaled score for each student.
4. The column labeled as **"D"** gives the students' status in terms of passing or failing the Mississippi Subject Area Test.
5. The item labeled as **"E"** denotes the minimum score needed to pass the Mississippi Subject Area Test.



Section II

Overview of the Mississippi Algebra I Curriculum

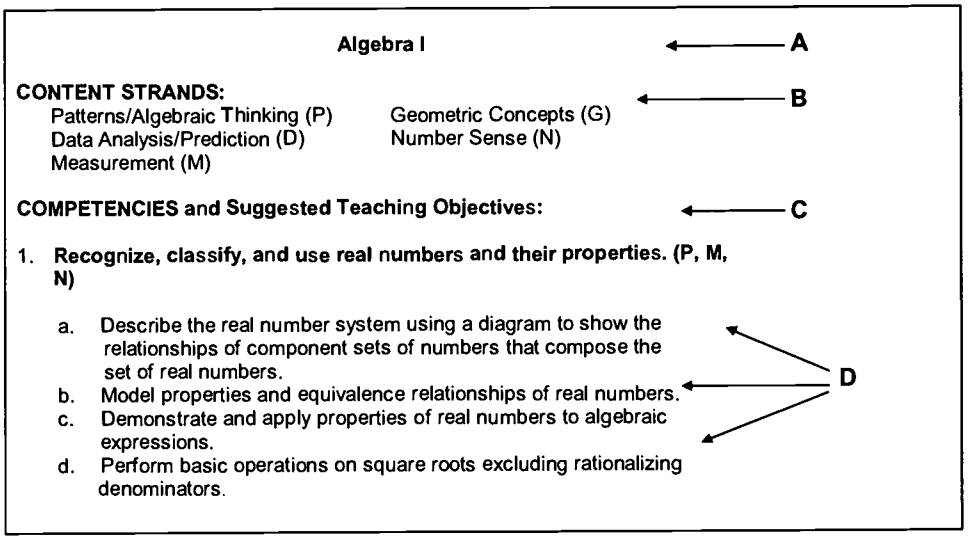
Organization of the Mississippi Mathematics Framework

The Framework is organized by grade level with elective courses listed at the end of the document. A description of the purpose and focus and an overview are found preceding each individual grade level curriculum.

The *Mississippi Mathematics 2000 Framework* format is described and outlined in the description and diagram below.

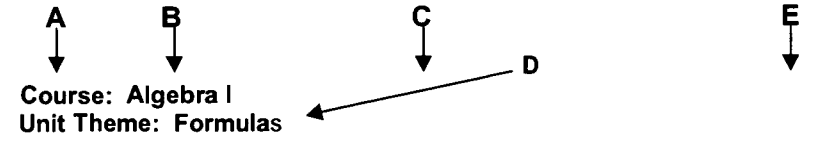
1. The item "**A**" denotes the ***course*** described.
2. The item "**B**" denotes the different subject area ***Strands*** integrated into the course that is described. There are five content strands (patterns/algebraic thinking, data analysis/prediction, measurement, geometric concepts, and number sense) and five process strands (problem solving/reasoning, estimating, incorporating technology, communicating and making connections/applications) in all mathematics courses.
3. The item "**C**" denotes the ***Competencies***. The Competencies represent the content *required* to be taught in the course.
4. The item "**D**" denotes the ***Suggested Teaching Objectives*** . The suggested objectives are not mandatory, but only suggested, to be used in teaching the course.

Framework Diagram:



Suggested Curriculum Guide

A. The **competency** to be taught is listed in the first column.
B. The **suggested objectives** for that competency are listed in the second column.
C. The **suggested teaching strategy** for the competency is listed in the third column.
D. The **topic or theme** to be taught is listed at the top of the page.
E. A **suggested method of assessment** for the teaching strategy is listed in the fourth column.



Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
5	a,b	Given a cardboard box, measure the length, width, and height to determine perimeter of a side, area of a side, and volume of the box. Find the diagonal of a side of the box. Extension: Determine the relationship between the dimensions of the box and the volume of the box.	• Rubric; Teacher Test
5 6	a,b f	Determine and justify comparable pricing for different size pizzas.	• Presentation; Rubric
5	a,d	Plot two points in a coordinate plane and use formulas to calculate length, midpoint, and slope. Make comparisons among the formulas used for calculations.	• Teacher test
5	c,e	On Index cards, write variables, symbols, operations, and the equal sign, one per card. As formulas are given verbally, demonstrate by holding up appropriate index cards. Extension: In pairs, demonstrate the "Golden Rule of Algebra" to solve for lengths using the perimeter formula.	• Observation
5	e	Draw a line segment with endpoints in different quadrants. Choose the appropriate formula to write the equation of the line formed using the line segment. Explain and show how standard form, point-slope formula, and slope-intercept formula are related.	• Teacher test

Algebra I Teacher Survey

The following survey was developed by a group of Mississippi teachers currently teaching Algebra I. The Office of Student Assessment disseminated the survey to Algebra I teachers across the state. Approximately 60% of teachers teaching Algebra I returned completed surveys. The results from the surveys were used by the Test Development Committee in designing the Algebra I Test Blueprint.

Algebra I Competencies and Objectives Survey

To be completed by Algebra 1 teachers only **Directions:** **1. For each of the competencies/skills listed below, circle "Yes" if you teach this in your classroom.** **2. Circle 1, 2, or 3 to indicate the emphasis you believe the Algebra 1 assessment should place on each competency/skill.** **3. Return the questionnaire to your principal for mailing.**	**Do you teach this competency /skill in your classroom?** **(Circle if yes)**	**How much emphasis should the Algebra I assessment place on this competency? (Circle one)** **1=Little or no emphasis** **2=Moderate emphasis** **3=Strong emphasis**
Competency # 1 **Recognize, classify, and use real numbers and their properties.**		
1.a Describe the real number system using a diagram to show the relationships of component sets of numbers that compose the set of real numbers.	Yes	1 2 3
1.b Model properties and equivalence relationships of real numbers.	Yes	1 2 3
1.c Demonstrate and apply properties of real numbers to algebraic expressions.	Yes	1 2 3
1.d Perform basic operations on square roots excluding rationalizing denominators.	Yes	1 2 3
Competency # 2 **Recognize, create, extend, and apply patterns, relations, and functions and their applications.**		
2.a Analyze relationships between two variables, identify domain and range, and determine whether a relation is a function.	Yes	1 2 3
2.b Explain and illustrate how change in one variable may result in a change in another variable.	Yes	1 2 3
2.c Determine the rule that describes a pattern and determine the pattern given the rule.	Yes	1 2 3
2.d Apply patterns to graphs and use appropriate technology.	Yes	1 2 3
Competency # 3 **Simplify algebraic expressions, solve and graph equations, inequalities and systems in one and two variables.**		
3.a Solve, check, and graph linear equations and inequalities in one variable, including rational coefficients.	Yes	1 2 3
3.b Graph and check linear equations and inequalities in two variables.	Yes	1 2 3
3.c Solve and graph absolute value equations and inequalities in one variable.	Yes	1 2 3
3.d Use algebraic and graphical methods to solve systems of linear equations and inequalities.	Yes	1 2 3
3.e Translate problem-solving situations into algebraic sentences and determine solutions.	Yes	1 2 3

Competency # 4 **Explore and communicate the characteristics and operations of polynomials.**				
4.a Classify polynomials and determine the degree.	Yes	1	2	3
4.b Add, subtract, multiply, and divide polynomial expressions.	Yes	1	2	3
4.c Factor polynomials using algebraic methods and geometric models.	Yes	1	2	3
4.d Investigate and apply real-number solutions to quadratic equations algebraically and graphically.	Yes	1	2	3
4.e Use convincing arguments to justify unfactorable polynomials.	Yes	1	2	3
4.f Apply polynomial operations to problems involving perimeter and area.	Yes	1	2	3
Competency # 5 **Utilize various formulas in problem-solving situations.**				
5.a Evaluate and apply formulas (e.g., circumference, perimeter, area, volume, Pythagorean Theorem, interest, distance, rate, and time).	Yes	1	2	3
5.b Reinforce formulas experimentally to verify solutions.	Yes	1	2	3
5.c Given a literal equation, solve for any variable of degree one.	Yes	1	2	3
5.d Using the appropriate formula, determine the length, midpoint, and slope of a segment in a coordinate plane.	Yes	1	2	3
5.e Use formulas (e.g., point-slope and slope-intercept) to write equations of lines.	Yes	1	2	3
Competency # 6 **Communicate using the language of algebra.**				
6.a Recognize and demonstrate the appropriate use of terms, symbols, and notations.	Yes	1	2	3
6.b Distinguish between linear and non-linear equations.	Yes	1	2	3
6.c Translate between verbal expressions and algebraic expressions.	Yes	1	2	3
6.d Apply the operations of addition, subtraction, and scalar multiplication to matrices.	Yes	1	2	3
6.e Use scientific notation to solve problems.	Yes	1	2	3
6.f Use appropriate algebraic language to justify solutions and processes used in solving problems.	Yes	1	2	3
Competency # 7 **Interpret and apply slope as a rate of change.**				
7.a Define slope as a rate of change using algebraic and geometric representations.	Yes	1	2	3
7.b Interpret and apply slope as a rate of change in problem-solving situations.	Yes	1	2	3
7.c Use ratio and proportion to solve problems including direct variation (y=kx).	Yes	1	2	3
7.d Apply the concept of slope to parallel and perpendicular lines.	Yes	1	2	3
Competency # 8 **Analyze data and apply concepts of probability.**				
8.a Collect, organize, graph, and interpret data sets, draw conclusions, and make predictions from the analysis of data.	Yes	1	2	3
8.b Define *event* and *sample spaces* and apply to simple probability problems.	Yes	1	2	3
8.c Use counting techniques, permutations, and combinations to solve probability problems.	Yes	1	2	3

Subject Area Test Blueprint

The following blueprint identifies the six assessment strands that are tested in Algebra I. Each strand has a specified number of questions that will appear on the Algebra I Subject Area Test. In addition to the specified number of questions, the blueprint identifies the competencies from the *Mississippi Mathematics 2000 Framework* that pertain to each assessment strand.

Blueprint Table-

Assessment Strand drawn from competencies | **Number of multiple choice items per assessment strand** | **Competencies with which assessment strand is aligned**

Assessment Strands	Multiple Choice Items	Competency
Numbers and number sense	5	1,2,3,4,5,6,7,8
Equations and Inequalities	18	3
Polynomials	9	4
Problem Solving	10	3,4,5,6,7,8
Slope	8	7
Probability	3	8
Total	53 items	

- The total number of multiple choice items that are scored = 53
- The total number of open ended items that are scored = 1
- The total number of multiple choice items that are field tested = 10*
- The total number of open ended items that are field tested = 1*

Total number of test items = 65

* **Note** - *Field test items are **not** included in the student's score.*

Correlation of the Assessment Strands to the Mathematics Framework for Algebra I

	Assessment Strand/Substrands	Algebra I Framework Competencies
1	**Numbers and Number Sense (Patterns, Relations, and Functions)**	**2. Recognize, create, extend, and apply patterns, relations, and functions and their applications.**
1a	Domain, range, and function	2a. Analyze relationships between two variables, identify domain and range, and determine whether a relation is a function.
1b	Change in a variable	2b. Explain and illustrate how change in one variable may result in a change in another variable.
1c	Rule	2c. Determine the rule that describes a pattern and determine the pattern given the rule.
1d	Applications of patterns to graphs	2d. Apply patterns to graphs and use appropriate technology.

	Assessment Strand/Substrands	Algebra I Framework Competencies
2	**Equations and Inequalities**	**1. Recognize, classify, and use real numbers and their properties.** **3. Simplify algebraic expressions, solve and graph equations, inequalities, and systems in one and two variables.** **6. Communicate using the language of algebra.**
2a	Properties and equivalence relationships	1b. Model properties and equivalence relationships of real numbers.
2b	Applications of real numbers to algebraic expressions	1c. Demonstrate and apply properties of real numbers to algebraic expressions.
2c	Linear equations and inequalities in one variable	3a. Solve, check, and graph linear equations and inequalities in one variable, including rational coefficients.
2d	Linear equations and inequalities in two variables	3b. Graph and check linear equations and inequalities in two variables.
2e	Absolute value	3c. Solve and graph absolute value equations and inequalities in one variable.
2f	Systems of equations/inequalities	3d. Use algebraic and graphical methods to solve systems of linear equations and inequalities.
2g	Problem solving	3e. Translate problem-solving situations into algebraic sentences and determine solutions.
2h	Terms, symbols, and notations	6a. Recognize and demonstrate the appropriate use of terms, symbols, and notations.
2i	Verbal and algebraic expressions	6c. Translate between verbal expressions and algebraic expressions.
2j	Matrices	6d. Apply the operations of addition, subtraction, and scalar multiplication to matrices.

	Assessment Strand/Substrands	Algebra I Framework Competencies
3	**Polynomials**	**4. Explore and communicate the characteristics and operations of polynomials.**
3a	Degree	4a. Classify polynomials and determine the degree.
3b	Four basic operations	4b. Add, subtract, multiply, and divide polynomial expressions.

3c	Factoring	4c. Factor polynomials using algebraic methods and geometric models.
3d	Application of real number solutions to quadratic equations	4d. Investigate and apply real-number solutions to quadratic equations algebraically and graphically.
3e	Unfactorable polynomials	4e. Use convincing arguments to justify unfactorable polynomials.
3f	Perimeter and area	4f. Apply polynomial operations to problems involving perimeter and area.

	Assessment Strand/Substrands	Algebra I Framework Competencies
4	**Formulas in Problem Solving**	**5. Utilize various formulas in problem-solving situations.** **6. Communicate using the language of algebra.**
4a	Application of formulas	5a. Evaluate and apply formulas (e.g., circumference, perimeter, area, volume, Pythagorean Theorem, interest, distance, rate, and time).
4b	Literal equations	5c. Given a literal equation, solve for any variable of degree one.
4c	Formula application in a coordinate plane	5d. Using the appropriate formula, determine the length, midpoint, and slope of a segment in a coordinate plane.
4d	Equation of lines	5e. Use formulas (e.g., point-slope and slope-intercept) to write equations of line.
4e	Scientific notation	6e. Use scientific notation to solve problems.

	Assessment Strand/Substrands	Algebra I Framework Competencies
5	**Slope**	**7. Interpret and apply slope as a rate of change.**
5a	Algebraic and geometric representations	7a. Define slope as a rate of change using algebraic and geometric representations.
5b	Interpret and apply in problem solving situations	7b. Interpret and apply slope as a rate of change in problem-solving situations.
5c	Application of ratio and proportion	7c. Use ratio and proportion to solve problems including direct variation (y=kx).
5d	Parallel and perpendicular lines	7d. Apply the concept of slope to parallel and perpendicular lines.

	Assessment Strand/Substrands	Algebra I Framework Competencies
6	**Probability**	**8. Analyze data and apply concepts of probability.**
6a	Collect, organize, graph, and interpret data sets	8a. Collect, organize, graph, and interpret data sets, draw conclusions, and make predictions from the analysis of data.
6b	Events and sample spaces	8b. Define *event* and *sample spaces* and apply to simple probability problems.
6c	Counting techniques, permutations, combinations	8c. Use counting techniques, permutations, and combinations to solve probability problems.

ALGEBRA I

The *Algebra I* course will provide opportunities for students to develop and communicate an understanding of algebraic representation as a prerequisite to all higher mathematics courses. Concepts covered in this course include real numbers and their properties, functions, algebraic expressions, linear equations and inequalities, systems of equations and inequalities, graphing polynomials, formulas, slope, data analysis and probability. The use of graphing calculators will be an integral part of this course. This course is designed to prepare students for Geometry and/or Algebra II. This is a one-credit course.

The competencies are printed in bold face type and are required to be taught. The competencies combine the content strands: **patterns/algebraic thinking**, **data analysis/prediction, measurement, geometric concepts**, and **number sense**, and the process strands: **problem solving/reasoning**, **estimating**, **incorporating technology**, **communicating**, and **making connections/applications**. The competencies may relate to one, many, or all of the mathematics curriculum strands and may be combined and taught with other competencies throughout the school year. Competencies are not listed in order of importance; rather the sequence of competencies relates to the broader K-12 framework. Competencies provide a general guideline of on-going instruction, not isolated units, activities, or skills.

The suggested teaching objectives are optional. Objectives indicate concepts that enable fulfillment of competencies, describe competencies in further detail, or show the progression of concepts throughout the grades. School districts may adopt the objectives, modify them, and are encouraged to write their own objectives to meet the needs of students in their school district.

ALGEBRA I

CONTENT STRANDS:

Patterns/Algebraic Thinking (P)
Data Analysis/Prediction (D)
Measurement (M)
Geometric Concepts (G)
Number Sense (N)

COMPETENCIES and Suggested Teaching Objectives:

1. **Recognize, classify, and use real numbers and their properties. (P, M, N)**
   a. Describe the real number system using a diagram to show the relationships of component sets of numbers that compose the set of real numbers.
   b. Model properties and equivalence relationships of real numbers.
   c. Demonstrate and apply properties of real numbers to algebraic expressions.
   d. Perform basic operations on square roots excluding rationalizing denominators.

2. **Recognize, create, extend, and apply patterns, relations, and functions and their applications. (P, D, G, N)**

   a. Analyze relationships between two variables, identify domain and range, and determine whether a relation is a function.
   b. Explain and illustrate how change in one variable may result in a change in another variable.
   c. Determine the rule that describes a pattern and determine the pattern given the rule.
   d. Apply patterns to graphs and use appropriate technology.

3. **Simplify algebraic expressions, solve and graph equations, inequalities and systems in one and two variables. (P, D, G, N)**

   a. Solve, check, and graph linear equations and inequalities in one variable, including rational coefficients.
   b. Graph and check linear equations and inequalities in two variables.
   c. Solve and graph absolute value equations and inequalities in one variable.
   d. Use algebraic and graphical methods to solve systems of linear equations and inequalities.
   e. Translate problem-solving situations into algebraic sentences and determine solutions.

ALGEBRA I

CONTENT STRANDS:

Patterns/Algebraic Thinking (P)
Data Analysis/Prediction (D)
Measurement (M)
Geometric Concepts (G)
Number Sense (N)

COMPETENCIES and Suggested Teaching Objectives:

4. Explore and communicate the characteristics and operations of polynomials. (P, M, G, N)

a. Classify polynomials and determine the degree.
b. Add, subtract, multiply, and divide polynomial expressions.
c. Factor polynomials using algebraic methods and geometric models.
d. Investigate and apply real-number solutions to quadratic equations algebraically and graphically.
e. Use convincing arguments to justify unfactorable polynomials.
f. Apply polynomial operations to problems involving perimeter and area.

5. Utilize various formulas in problem-solving situations. (P, D, M, G, N)

a. Evaluate and apply formulas (e.g., circumference, perimeter, area, volume, Pythagorean Theorem, interest, distance, rate, and time).
b. Reinforce formulas experimentally to verify solutions.
c. Given a literal equation, solve for any variable of degree one.
d. Using the appropriate formula, determine the length, midpoint, and slope of a segment in a coordinate plane.
e. Use formulas (e.g., point-slope and slope-intercept) to write equations of lines.

6. Communicate using the language of algebra. (P, D, M, G, N)

a. Recognize and demonstrate the appropriate use of terms, symbols, and notations.
b. Distinguish between linear and non-linear equations.
c. Translate between verbal expressions and algebraic expressions.
d. Apply the operations of addition, subtraction, and scalar multiplication to matrices.
e. Use scientific notation to solve problems.
f. Use appropriate algebraic language to justify solutions and processes used in solving problems.

ALGEBRA I

CONTENT STRANDS:

Patterns/Algebraic Thinking (P)
Data Analysis/Prediction (D)
Measurement (M)
Geometric Concepts (G)
Number Sense (N)

COMPETENCIES and Suggested Teaching Objectives:

7. Interpret and apply slope as a rate of change. (P, D, M, G, N)

a. Define slope as a rate of change using algebraic and geometric representations.
b. Interpret and apply slope as a rate of change in problem-solving situations.
c. Use ratio and proportion to solve problems including direct variation ($y = kx$).
d. Apply the concept of slope to parallel and perpendicular lines.

8. Analyze data and apply concepts of probability. (P, D, M, G, N)

a. Collect, organize, graph, and interpret data sets, draw conclusions, and make predictions from the analysis of data.
b. Define *event* and *sample spaces* and apply to simple probability problems.
c. Use counting techniques, permutations, and combinations to solve probability problems.

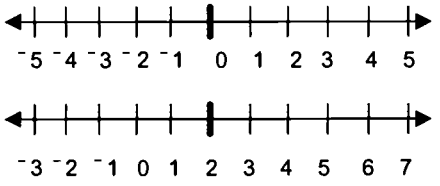
Course: **Algebra I**
Unit Theme: **Real Numbers**

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
1	a	Write a journal, paragraph, or story to explain how the set of real numbers is like a family tree.	• Rubric
1	b	Write each of the following on small individual paper squares: A, A, B, B, C, C, -, +, x, ÷, IF, and THEN, =, ( ), and 0. Use these to model properties and equivalence relationships.	• Teacher observation
1 6	c f	Create foursomes such as: $3(x+4) = 3x + 12$ | $3x + 2x = 5x$ Distributive Property | $5x + 3 = 3 + 5x$ Which one does not belong? Explain.	• Teacher test; Constructed response
1	d	Find the perimeter and area of a rectangle with radical terms as dimensions.	• Teacher test
1 6	b, c, d f	Use and identify appropriate properties to explain a computational procedure. Extension: Given a real world or mathematical problem identify the operational strategies involved and justify.	• Teacher test; Constructed response

Course: Algebra I
Unit Theme: Patterns

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
2 7	a, b, d a	Using equations involving rational numbers, such as $y = .05x$ to represent the value of *x* nickels, explore how changes in *x* affect *y*. Identify domain as nickels and range as value. Use a T-chart to graph the relation and verify with graphing calculator.	• Rubric
2	c	Use algebraic expressions to represent consecutive even or odd integers that have a particular sum. Given a set of consecutive even or odd integers, write a verbal expression to represent the set.	• Rubric

Course: Algebra I
Unit Theme: Graphing

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
3	a	Use manipulatives (e.g., algebra tiles or Algeblocks) to model the process of solving linear equations. Check solutions using the graphing calculator or substitution.	• Teacher test
3	b	Group students in pairs. Give each pair a set of linear equations directing one student to graph using a graphing calculator and the other not using a calculator. Compare results and switch roles.	• Observation
3	c	Create a "zero finder" as pictured to illustrate the absolute value as a distance from the origin. For example: $\|x-2\|=5$  Position with zero on the zero finder above the two on the number line because two makes the expression inside the absolute value zero. The solutions to the equation are five units from two on the number line.	• Teacher test
3	d	Use colored pencils to sketch and shade systems of linear inequalities.	• Teacher test
3	d	Use Algebra Tiles and the graphing calculator to solve systems of equations.	• Rubric
3	d	Compare solutions of systems of equations versus inequalities. Use the graphing calculator to explore the different outcomes.	• Observation
3	e	Create constructed response items that involve translating problem-solving situations into algebraic sentences. Have students solve and exchange papers.	• Teacher test; Rubric

Course: Algebra I
Unit Theme: Polynomials

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
4 6	a a	On each wall of the classroom, put the classifications of polynomials. Write assigned polynomials on index cards and place on the correct wall. In groups of four, assign a degree to each group and have them create a polynomial of that degree and present to large group.	• Observation
4	b, c, f	Given a rectangle of given length and width, extend the length and width by a variable and find the perimeter and area. Given the area of a rectangle in one variable, find the length and width.	• Teacher test
4	b	Use the algebra tiles to model operations with polynomial expressions.	• Teacher test
4	c, d	Use the quadratic formula to solve trinomial equations, and use solutions to write binomial factors.	• Teacher test
4	d	Graph quadratic equations on a graphing calculator to relate the x-intercepts to solutions.	• Teacher test
4 6	e f	Use a graphing calculator to graph a quadratic equation with no x-intercepts. Relate to the connections among x-intercepts, real solutions, and factors.	• Teacher test
4	b, c, f	Use algebra tiles to determine factors of a polynomial expression.	• Observation
4 5	b, c, f a	Use algebra tiles to create a rectangle of any area. Determine the dimensions and perimeter of the sketched rectangle.	• Constructed response

Course: Algebra I
Unit Theme: Formulas

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
5	a, b	Given a cardboard box, measure the length, width and height to determine perimeter of a side, area of a side, and volume of the box. Find the diagonal of a side of the box. Extension: Determine the relationship between the dimensions of the box and the volume of the box.	• Rubric; Teacher test
5 6	a, b f	Determine and justify comparable pricing for different size pizzas.	• Presentation; Rubric
5	a, d	Plot two points in a coordinate plane and use formulas to calculate length, midpoint, and slope. Make comparisons among the formulas used for calculations.	• Teacher test
5	c, e	On index cards, write variables, symbols, operations, and the equal sign, one per card. As formulas are given verbally, demonstrate by holding up appropriate index cards. EXTENSION: In pairs, demonstrate the "Golden Rule of Algebra" to solve for lengths using the perimeter formula.	• Observation
5	e	Draw a line segment with endpoints in different quadrants. Choose the appropriate formula to write the equation of the line formed using the line segment. Explain and show how standard form, point-slope formula, and slope-intercept formula are related.	• Teacher test

Course: Algebra I
Unit Theme: Communication

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
6	a, b	Given several equations, classify as linear or non-linear and verify with a graphing calculator.	• Observation; Teacher test
6	c	From two lists, match the algebraic expressions to their corresponding verbal expressions. Extension: Create a real-world problem using the corresponding matched algebraic and verbal expressions.	• Rubric; Teacher test
6	d	Using two different brands of regular and diet soft drinks arrange the price of each in matrix form and show the price doubling by using scalar multiplication.	• Teacher test
6	a, e	Using states that are rectangular in shape, estimate their actual area in square feet. Express the estimated area in scientific notation.	• Presentation
6	e, f	Explore problems involving scientific notation using the graphing calculator. Explain the difference between multiplying by a positive power of ten and by a negative power of ten.	• Rubric
6	a, e, f	Give examples of large numbers or small numbers containing more than three non-zero digits correctly represented in scientific notation. Explain and justify each example.	• Rubric

Course: Algebra I
Unit Theme: Slope

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
7	a, b	Relate income to the number of hours worked in equations such as: $y = \$5.25x$ and $y = \$15.85x$ Use the graphing calculator to compare the change of income (y) as it relates to the change in hourly wage (slope).	• Teacher test
7	a, b	Place a yardstick across the incline of a set of steps. Measure the vertical change versus the horizontal change, then explore how changing these distances affect the steepness of the steps.	• Rubric
7	c	Using a bicycle, demonstrate how the revolutions of the pedal and the rear wheel illustrate the concept of direct variation. For example, $y = 3x$. (In a particular gear, perhaps the ratio is 3 to 1) x = number of revolutions of pedal y = number of revolutions of rear wheel	• Teacher test
7	d	Using a graphing calculator, graph a series of equations to discover the relationship of slope to parallel and perpendicular lines.	• Observation

Course: Algebra I
Unit Theme: Probability

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
8	a	In groups, assign each a topic from which to design and conduct a survey. Compile, graph, and interpret results and present to class. Extension: Use computer graphing software to organize collected data.	• Rubric
6 8	a b	Define "events" and "sample space" for experiments involving number cubes, spinners, coin flipping, and cards.	• Observation
6 8	f c	Determine how many handshakes there would be between five people if everyone had to shake hands with each person exactly once. Explain or sketch how the answer was determined.	• Rubric

Section III

Suggested Testing Strategies

The Algebra I Subject Area Test measures a student's knowledge of, and skill level in, applied algebra. There are 63 multiple-choice items and two open-ended items. Many enhanced multiple-choice items contain charts, graphs, or diagrams that the student will use to determine the correct answer. The open-ended items require the student to analyze a question and respond in writing. Students may be asked to sketch a graph or explain their use of a graphing calculator to solve a problem when responding to an open-ended item.

Multiple Choice Items

For the Student:

- ***Read everything carefully.***

Many of the Algebra I Subject Area Test questions have tables, charts, graphs, and diagrams. All test questions require careful reading of the directions and the question as well as the four answer choices.

- ***Consider every choice.***

You must choose, from four alternatives, the answer that best addresses the question.
Some of the alternatives (distractors) will look attractive because they include an irrelevant detail, a common misconception, or apply the right information in the wrong way.

- ***Spend test time wisely.***

Many tests are arranged so that the easiest items are first and the hardest are last. The Mississippi Subject Area Tests are not arranged that way. Questions are randomly inserted with an emphasis on ensuring that it is not chronologically set up. This random arrangement does occasionally line up hard questions followed by easier ones, but this is random and not by design. If you do run into a few hard questions, move past them to those you know you can answer, then go back to the harder ones and reattempt to answer them.

- ***Check your work.***

There are several places where carelessness can cause you to answer incorrectly. The first is the initial reading of the question. Read everything carefully. The second is in choosing the answer. You should evaluate each answer option critically to make sure it actually answers the question. The third possibility for making a mistake is in the transfer of the correct answer to your answer sheet. You should ask yourself two questions: "Am I on the right question number in the right section of the test?" and " Is this the answer I mean to mark?"

For the Teacher:

Exposure to a variety of types of multiple-choice questions is crucial to any student's success on the Algebra I Subject Area Test. There are numerous considerations, however, when constructing or choosing multiple- choice questions.

1. With respect to the item as a whole , the teacher must consider whether:
   a. The item tests knowledge of a skill that is worthwhile and appropriate for all students.
   b. There is a significantly better way to measure what the item tests.
   c. The item is within the appropriate range of difficulty for the intended student population.

2. With respect to the stem, the teacher should consider whether the item:
   a. Poses a clearly defined problem or task.
   b. Contains only necessary information.
   c. Can be worded more clearly or concisely.

3. With respect to the options, the teacher should consider whether:
   a. They are reasonably parallel in structure.
   b. They fit logically and grammatically with the stem.
   c. They can be worded more clearly and concisely.
   d. They are so inclusive that they logically eliminate another more restricted option from being the unique key.

When using tests written by others-

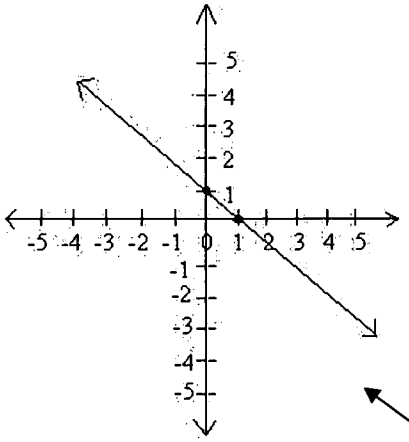
4. With respect to the key (best answer), the teacher should determine:
   a. Which option the teacher thinks is intended to be the correct answer. (In cases where the item writers have actually marked the key, verify that your choice agrees with theirs.)
   b. Whether the key actually answers the question posed.
   c. Whether the key needs to be made less obvious in relation to the other options or the stem (Should it be – shorter, longer, more detailed, more abstract?).

5. With respect to the distractors, the teacher should consider whether:
   a. There is any possible justification for considering one of them as an acceptable response to the question.
   b. They are sufficiently plausible to attract students who are misinformed or inadequately prepared. (The distractors, however, must not be a set of irrelevant responses.)
   c. Any of them unnecessarily calls attention to the key. For example, no option should simply state the opposite of the key or, conversely, resemble the key very closely, unless another pair of options involves similar opposition or parallelism.

Analyzing a Test Question

The following terms describe the various components of a multiple choice item:

Stimulus – The piece of art or referent that prompts a response.
Stem – The item stem actually states the problem. This can be posed as a question or as an incomplete statement.
Distractor- The incorrect answers to a multiple-choice item.
Key – The correct choice to a multiple-choice item.



Stimulus

Which of these equations represents the graph shown above? ← **Stem**

A. $y = x + 1$ ← Distractor
B. $y = x - 1$ ← Distractor
C. $y = -x + 1$ ← Key
D. $y = -x - 1$ ← Distractor

← **Options**

The Algebra I Subject Area Test has many questions, such as the example above, that are generally referred to as *Enhanced Multiple Choice* questions. Most utilize external graphs, charts, tables, or diagrams from which the student is to draw information to formulate a response. Some of these questions require the student to demonstrate a significant degree of problem-solving, reasoning, making connections, and application skills.

Open-Ended Items

Showing Work and/or Explaining Reasoning

Points to Remember

1. Students must show their work and/or explain their reasoning in order to benefit from the partial credit model that is used to score the Algebra I constructed-response items. The Mississippi Rubric for Open-Ended Items was designed to help students receive credit for all that they know and all that they can do.

2. Teachers should explain the scoring procedure very early in the school year and should provide students with many opportunities to see how the scoring process works. All students should understand that the scoring method is designed to help them.

3. As frequently as possible, teachers should score student work using the Rubric for Open-Ended Items.

4. Students should use the Constructed-Response Rubric to do self-scoring of some of their own work or the work of their peers.

5. Since it is most often writing that allows students to reveal their problem-solving processes, writing should be a part of every activity that occurs in Algebra I classes.

Explaining Process When A Calculator Is Used

Students are encouraged to use their graphing calculators throughout the Algebra I test. However, because students can and do make mistakes while using calculators, it is important for them to explain briefly the process they are using in order to receive full benefit from the partial credit model used for scoring the open-ended items. The Mississippi Rubric for Open-Ended Items makes it quite clear that a correct answer with no justification will receive a score of 1.

Suggestions:

1. Make the policy related to the explaining process clear to students early in the school year.

2. Give students frequent opportunities to explain the process they are using with the calculator in problem-solving activities.

3. Provide students with copies of the Mississippi Rubric for Open-Ended Items.

4. Allow students the opportunity to score their own or participate in scoring other students' papers.

5. Share samples that indicate how calculator processes might be explained with students.

Following Directions

Some assessment objectives and instructional targets are very specific. An example under the Open Sentences domain is:

Write or solve quadratic equations.

In order to measure these objectives, constructed-response items are worded carefully and specifically. To receive a score of 4, students must follow the directions given in the item. In some of these items, a particular strategy or method will be required. The philosophy of the SATP is to reward divergent thinking, to honor students' unique approaches to problem solving, and to award partial credit for partial knowledge. In keeping with this philosophy, most constructed-response items on the test will allow students to select and apply the strategy of their choice. However, some constructed-response test items will assess traditional skills and concepts of algebra as required by the competencies and objectives listed in the *Mississippi Mathematics 2000 Framework*. For example, some items may include the following phrases:

Write a quadratic equation that models . . .

Use matrices to solve . . .

Write and solve a system of equations . . .

Use the slope formula to find . . .

Graph a line parallel to . . . (rather than displaying it on a calculator)

Write and solve a linear equation . . .

Use your graphing calculator to . . .

Note: If a student uses a strategy different from the one required by the item to arrive at a correct solution, it is possible for the response to earn a score of 3.

Early in the year, teachers should explain the scoring policy to students and should provide them with ample opportunities to respond to the type of question that requires a particular method as well as to the type that allows them to select their own strategy.

Scoring Open-Ended Items

To help the student understand what your expectations are, involve your students in the creation or use of a scoring rubric. This allows the student to know where the targets of your assignments or questions are and allows them to be involved with the process. The involvement will also motivate students to "buy into" the work and strive to do their best. The most common holistic rubrics are like the one that Mississippi uses for its scoring of constructed response questions on the Algebra I Test. It has five score levels. (See p. 37.)

To help prepare students for this type of question, construct or reproduce this style rubric and pass them out to the students. A few non-recorded assignments should be assigned and the students allowed to grade each others papers using this rubric in order to give students experience and insight as to how the rubric will be used to grade their responses.

Mississippi Subject Area Testing Program - Algebra I Rubric for Open-Ended Items

Student responses to open-ended items receive a score of 0, 1, 2, 3, or 4, based on the following rubric:

4 The student response

- offers a correct solution and is supported by well-developed, accurate explanations.
- contains evidence that an appropriate problem-solving strategy was selected and implemented, but may contain minor inaccuracies that do not detract from the overall quality of the response.
- is clearly focused, well-organized, and shows a mathematical understanding of the concept or task.
- contains sufficient detail to convey thorough understanding of the problem.

3 The student response

- offers a generally correct solution, but contains minor flaws in reasoning or computation.
- provides evidence that an appropriate problem-solving strategy was selected, but may contain minor arithmetic or algebraic errors that do detract from the overall quality of the response.
- is clearly focused, well-organized, but may neglect some aspect of the complete solution or explanation.
- lacks significant detail to convey thorough understanding of the problem.

2 The student response

- offers a partially correct interpretation and/or solution to the problem.
- may contain flaws indicating an incomplete understanding of the concept or task.
- may exhibit faulty reasoning leading to weak conclusions.
- may demonstrate unclear communication in writing or diagrams.
- may demonstrate a poor understanding of relevant mathematical procedures or concepts.

1 The student response

- offers a correct solution with no supporting evidence or explanation.
- provides a vague interpretation and/or solution, indicating minimal mathematical understanding of the concept or task.
- attempts to address issues relevant to the concept or task, but includes numerous errors that significantly detract from the overall quality of the response.
- offers little or no supporting detail that conveys limited understanding.

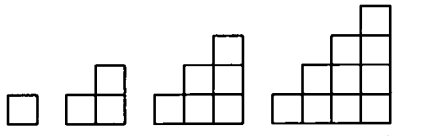
0 The student response

- indicates no mathematical understanding of the concept or task.
- does not address the problem.
- offers an incorrect interpretation.
- is off-topic.
- is written in a foreign language.
- is written illegibly.
- is a copy of the item.
- is a refusal to respond.
- is blank.
- is incomprehensible.

Section IV

Additional Strategies and Sample Assessment Items

Competency/Objective	Assessment Strand - Teaching Strategies/Concepts
Competency 2. **Recognize, create, extend, and apply patterns, relations, and functions and their applications.** ***Objective –a*** *Analyze relationships between two variables, identify domain and range, and determine whether a relation is a function.* Sample Question 1.1----------	**(1) Numbers and Number Sense (Patterns, Relations, and Functions)** (2a.1) Describe functions in terms of input and output. The x-value (domain) is the input (independent variable) and the y-value (range) is the output (dependent variable).(i.e. The value of y depends on the value of x. (2a.2) Have students describe the vertical line test for determining whether or not a relation is a function in their own words. Students should understand that you should be able to sketch an infinite number of vertical lines and none of them should intersect the graph in more than 1 point, if it IS a function. (2a.3) Use the WINDOW on a graphing calculator to assist students in determining domain and range of a function.
Objective –b *Explain and illustrate how change in one variable may result in a change in another variable.* Sample Question 1.2----------	(2b.1) Provide each student with an index card with a function written on it. Roll a number cube to determine an input or x-value. Students evaluate their function for that value and pass the cards. Continue passing the cards until every student has had an opportunity to evaluate each function with that x-value. (2b.2) Have students use the TABLE function on a graphing calculator to determine y-values for given x-values.

Objective—c *Determine the rule that describes a pattern and determine the pattern given a rule.* Sample Question 1.3----------  (1,1) (2,3) (3,6) (4,10)	(2c.1) Have students use unifix cubes, centimeter squares, or some other manipulative to investigate the number of blocks needed to form a specific number of stairs. The stairstep number would be the x-value and the number of blocks needed would be the y-value. Have students look for a pattern and determine the number of blocks needed to form a staircase of 50 steps. Have students write a function that describes this pattern. (2c.2) Have students play "Function Concentration". One set of cards should have functions written on each and a second set of cards should have a pattern that results from the functions. All cards are turned over and students try to match the functions to their corresponding patterns.
Objective—d *Apply patterns to graphs and use appropriate technology.* Sample Question 1.4----------	(2d.1) Have students graph the equation, y=x on a graphing calculator. Then, have students add the following graphs to the calculator one at a time: y=x+1, y=x+2, and y=x+3. Have students discuss what changes occurred in the graphs. Also, use the TABLE to compare and contrast the patterns formed from each function. Repeat this process with several other families of graphs.

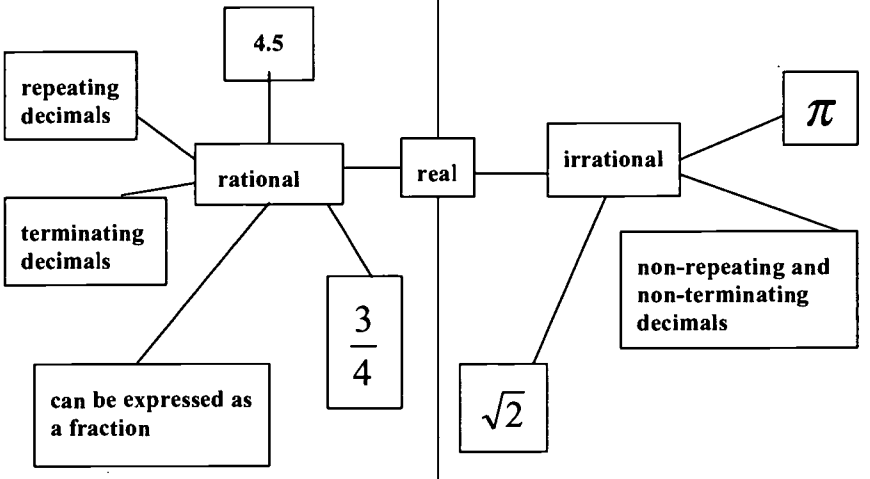
Competency 1. **Recognize, classify, and use real numbers and their properties.**
Objective—a
Describe the real number system using a diagram to show the relationships of component sets of numbers that compose the set of real numbers.

(2) Equations and Inequalities

(1a.1) Have the students analyze and define the following sets of real numbers: integers, whole numbers, rational numbers, irrational numbers, and natural numbers.

(1a.2) Have the students create 6 columns labeled with the terms whole, natural, integer, rational, irrational, and real. Under each column list at least 10 numbers that apply to that category. Discuss whether some numbers could be placed in multiple categories.

(1a.3) Have the students create a comparison map of rational and irrational numbers.



Objective—b
Model properties and equivalence relationships of real numbers.
Sample Question 2.1----------

(1b.1) Have the students create 8 columns labeled: commutative property of addition, commutative property of multiplication, associative property of addition, associative property of multiplication, identity property of addition, identity property of multiplication, multiplicative property of zero, and distributive property. The students should place 5 equations under each category that models that particular property.

(1b.2) Provide small groups of 5 students each with a number cube. Each student should roll the cube 1 time. The students should use the 5 numbers rolled once each and any mathematical operation or property to create the largest (or smallest) number possible. The student with the largest number gets a point. The first student to get 5 points is the winner.

2(x + 1) =

1	x	1
1	x	1
	x	1

(1b.3) Use algebra tiles to illustrate the distributive property from a geometric perspective.
EX: Create a rectangle to represent 2(x+1). The length should be x+1 and the width should be 2. Create a second rectangle to represent 2x+2. The length should be 2x+2 and the width should be 1. Students should discover that the areas are the same despite the arrangement, therefore, 2(x+1)=2x+2.

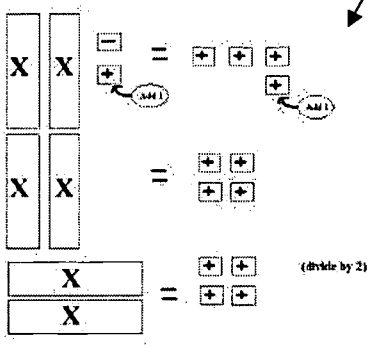
1 (2x + 2) =

1	x	x	1	1
	x	x	1	1

Objective—c
Demonstrate and apply properties of real numbers to algebraic expressions.
Sample Question (2.2)----------

(1c.1) Have students play "Property Rummy". Provide small groups with a deck of teacher-made cards. A set would consist of 3 cards with the following on each; the property name, algebraic model of the property, and a numerical equation representing the property. Some incorrect equations should also be included.

	(1c.2) Provide students with a set of equations where the left hand side is a multi-step algebraic expression and the right-hand side represents its simplified form. Have students determine which equations are true and which are false, correct the mistakes, and identify the property(ies) used to simplify the expression. (1c.3) Provide students with a teacher-made deck of cards to play "Concentration". One card should have the name of the property and its match should have an algebraic equation that illustrates the property.
Objective—d *Perform basic operations on square roots excluding rationalizing denominators.*	(1d.1) Have students discover the difference between "square" and "square root" by using a geometric model. EX: Given a square with sides that are 3 inches long, the area is found by *squaring* 3. Given the area of a square is 9 square inches, then the length of the side is found by determining the *square root* of 9. (1d.2) Have students list the numbers 1 to 25 in one column. In a second column, determine the square of each number. Discuss the correlation between the two columns.(i.e. column 2 is the *square* of column 1 and column 1 is the *square root* of column 2.) (1d.3) Have students perform basic operations on several problems involving square roots, emphasizing that "like terms" are those that contain the same simplified square root. EX: $-2\sqrt{3}+4\sqrt{3}+2\sqrt{5}=2\sqrt{3}+2\sqrt{5}$

Competency 3. **Simplify algebraic expressions, solve and graph equations, inequalities and systems in one and two variables.** ***Objective—a*** *Solve, check, and graph linear equations and inequalities in one variable, including rational coefficients.* Sample Question 2.3----------  	(3a.1) Use algebra tiles or other manipulatives to model the process for solving linear equations in one variable. EX: 2x-1=3 (3a.2) Have students graph the left-hand side of the equation and the right-hand side of the equation separately using a graphing calculator. The x-value of the point of intersection of the two graphs will be the solution. (3a.3) Have students use a flow chart to demonstrate the steps to solving a linear equation in one variable. (3a.4) Provide each student with an index card containing an equation that is worked out and solved INCORRECTLY. Have the students determine the mistake and solve the equation correctly. Continue passing the cards until every student has had an opportunity to solve each equation. (3a.5) Have students create an equation calendar. The students should create multi-step equations that would have a solution that corresponds to each date. (EX: 2x+1=3; x=1; therefore, this equation could be used for the first day of the month.) Have students solve and check each equation they create.
Objective—b *Graph and check linear equations and inequalities in two variables.* Sample Question 2.4----------	(3b.1) Have students graph linear equations and inequalities on graph paper and check by using a graphing calculator. (3b.2) Sketch the graph of a linear equation on the board. Provide each student a card with an ordered pair written on the card. Each student comes to the board and places the ordered pair in the appropriate place (on, above, or below the line).

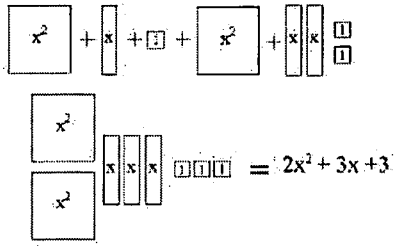
	(3b.3) Provide students with a pegboard labeled with a coordinate plane and golf tees. Given an equation, have students place 3 tees in appropriate holes in the pegboard. The tees should form a straight line. This could be used as a quick visual assessment.
Objective—c *Solve and graph absolute value equations and inequalities in one variable.* Sample Question 2.5----------	(3c.1) Have students use a graphing calculator to graph the left-hand side and the right-hand side of the equation separately. Students should discover that the graphs intersect at 2 points, where the x-values represent the 2 solutions. (3c.2) Use the one-dimensional circle concept for solving absolute value equations and inequalities. EX: $\|x-2\|=3$ reads as "the distance from x to 2 is 3 units." Therefore, the graph of this equation is the set of all points that are 3 units away from 2 on the number line. Using the circle concept, 2 is the center and 3 is the radius. Setting a compass on the center and using the given radius to sketch a circle shows that the 2 points where the circle intersects the number line are the 2 solutions.
Objective—d *Use algebraic and graphical methods to solve systems of linear equations and inequalities.* Sample Question 2.6----------	(3d.1) Have students use a graphing calculator to graph the two equations and determine the point of intersection. (3d.2) Given a system of inequalities, have students use one colored pencil to sketch the graph of the first inequality and a different colored pencil to sketch the graph of the second inequality. The area where the 2 colors overlap is the solution. (3d.3) Have students use matrices on a graphing calculator to check solutions to systems of equations.

	(3d.4) Have students graph any linear equation on a coordinate plane. Have them choose a point on the line and any point NOT on the line, and draw the line through those two points. Have students write the equation of the new line and substitute the point they chose on the first line into both equations. Discuss that they have created a system of equations and that the common point is the solution to that system.
Objective—e *Translate problem-solving situations into algebraic sentences and determine solutions.* Sample Question 2.7----------	(3e.1) Provide students with several problem-solving situations that involve translating them into algebraic sentences. Have students exchange papers and practice scoring them using the "Mississippi Rubric for Open-Ended Items". (3e.2) Provide students with several problem-solving situations. Have them highlight what is being asked for, define a variable, state in their own words the information given, and write an equation from this information. (3e.3) Have students create and solve original problem situations that could be solved using multi-step equations.
Competency 6. **Communicate using the language of algebra.** ***Objective—a*** *Recognize and demonstrate the appropriate use of terms, symbols, and notations.* Sample Question 2.8----------	(6a.1) Have students keep an ongoing glossary of terms, symbols, and notations in their notebook as they are discussed in class. Include various entries from the glossary on each unit test.
Objective—b *Distinguish between linear and non-linear equations.*	(6b.1) Provide students with a list of equations. Have them use a graphing calculator to determine which are linear and which are not.

	(6b.2) Draw a two-column table on the board. Label one column linear and the other non-linear. Provide each student with an index card with an equation written on it. Have students come to the board and place their card in the appropriate column. Have students write a paragraph comparing and contrasting the two columns.
Objective—c *Translate between verbal expressions and algebraic expressions.* Sample Question 2.9----------	(6c.1) Have students create a chart with columns labeled addition, subtraction, multiplication, and division. Students come up with words or phrases to represent the given operation in each column. (EX: Subtraction: decreased by, minus, less, subtract from, etc.) (6c.2) In small groups of three students, have the first student write an algebraic expression on an index card without showing the others in the group. The card is passed to the second student where he/she writes the expression in words on another card. That card is then passed to the third student who translates the words back into an algebraic expression. The first student then checks to see if the result matches their original expression.
Objective—d Apply the operations of addition, subtraction, and scalar multiplication to matrices. Sample Question 2.10----------	(6d.1) Use a graphing calculator to perform and/or check solutions to problems involving basic operations with matrices. (6d.2) Have students arrange prices of three different brands of regular and fat-free cookies in matrix form. Have them show the price doubling, then tripling by using scalar multiplication.
Objective—f *Use appropriate algebraic language to justify solutions and processes used in solving problems.*	(6f.1) Provide students with at least one open-ended item per unit test, which requires them to explain and justify the processes they used to solve the problem. Score the item using the "Mississippi Rubric for Open-Ended Items".

	(3) Polynomials
Competency 4. **Explore and communicate the characteristics and operations of polynomials.** ***Objective—a*** *Classify polynomials and determine the degree.* Sample Question 3.1----------	(4a.1) Label the four walls of the classroom with the following signs: monomial, binomial, trinomial, and neither. Give student an index card with an expression written on it. Have students stand by the wall that corres they have. Discuss results. (4a.2) Label the walls of the classroom with the numbers 1, 2, 3, 4,etc.. Provide each student an index card with a polynomial written on it. Students move to the wall corresponding to the degree of their polynomial. Have students read their polynomial aloud and discuss as a class whether or not they are in the appropriate place. (4a.3) Have students create a polynomial of their own that have a specified degree.

Objective—b
Add, subtract, multiply, and divide polynomial expressions.
Sample Question 3.2----------

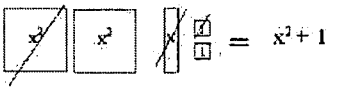


$x^2 + 3x + 2$

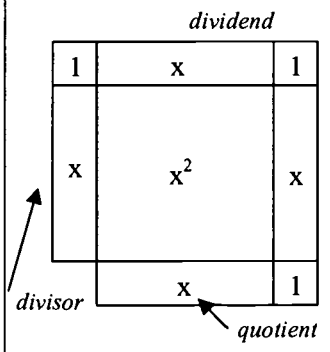
1	x	1	1
x	x^2	x	x
	x	1	1

(4b.1) Use algebra tiles to model addition and subtraction of polynomials.
EX: $(x^2+x+1)+(x^2+2x+2)$

EX: $(2x^2+x+2)-(x^2+x+1)$

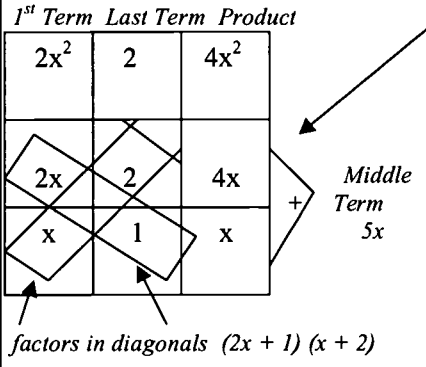


(4b.2) Use algebra tiles to model multiplication of polynomials. Let one polynomial represent the length and the other the width of a rectangle. Form a rectangle with the given dimensions and the resulting area is the answer.
EX: (x+1)(x+2)



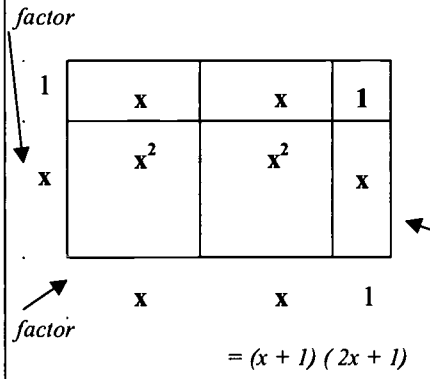
(4b.3) Use algebra tiles to model division of polynomials. The dividend represents the area of the rectangle and the divisor represents either the length or the width. Form a rectangle with the tiles representing the dividend beside the tiles representing the length. The width of the rectangle formed is the quotient.
EX: $(x^2+2x+1)\div(x+1)$

Objective—c
Factor polynomials using algebraic methods and geometric models.
Sample Question 3.3----------



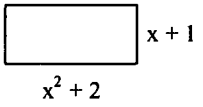
(4c.1) Have students factor polynomials using the "Tic-Tac-Toe" method.
EX: Factor the polynomial $2x^2+5x+2$

(4c.2) Have students factor polynomials of the form ax^2+bx+c, where $a\neq 1$ using the "Bottoms-Up" method.
EX: $2x^2+5x+2$
x^2+5x+4
$(x+4)(x+1)$
$(x+\frac{4}{2})(x+\frac{1}{2})$
$(x+\frac{2}{1})(x+\frac{1}{2})$
$(x+2)(2x+1)$
Step 1: Multiply $a \cdot c$.
Step 2: Rewrite in the form $1x^2 + bx + a \cdot c$.
Step 3: Factor using traditional methods.
Step 4: Divide the last terms of each factor by a and reduce.
Step 5: Bring denominator of each reduced fraction in front of x (Bottoms – Up).



(4c.3) Factor polynomials using algebra tiles. The polynomial represents the area of a rectangle and the dimensions of the rectangle are the factors.
EX: Factor $2x^2+3x+1$

	(4c.4) Factor polynomials of the form ax^2+bx+c, where $a \neq 1$ by grouping. EX: $2x^2+3x+1$ $2x^2+2x+1x+1$ $2x(x+1)+1(x+1)$ $(2x+1)(x+1)$ Step 1: Multiply $a \cdot c$. Step 2: Find 2 numbers that multiply to give this product and add to give b. Step 3: Rewrite bx as the sum or difference of the two terms. Step 4: Factor by grouping.
Objective—d *Investigate and apply real-number solutions to quadratic equations algebraically and graphically.* Sample Question 3.4----------	(4d.1) Have students set quadratic equations equal to zero. Enter the quadratic side of the equation into a graphing calculator and graph. The x-intercepts are the solutions. (4d.2) Have students explore the result of multiplying solutions to several quadratic equations of the form $ax^2+bx+c=0$. EX: $9x^2+5x-4=0$ $x=-1$ or $x=\frac{4}{9} \Rightarrow -1\cdot\frac{4}{9}=-\frac{4}{9}=\frac{c}{a}$ Students should discover that the product of the solutions is $\frac{c}{a}$.
Objective—e *Use convincing arguments to justify unfactorable polynomials.* Sample Question 3.5----------	(4e.1) Provide students with a set of algebra tiles and a list of 10 polynomials, some of which are factorable and some that are not. Have students attempt to form rectangles with the tiles to represent each of the given polynomials. Students should discover that a rectangle can not be formed if the polynomial is prime. NOTE: Some polynomials may require adding "zero pairs" in order to form the rectangle.

Objective—f ***Apply polynomial operations to problems involving perimeter and area.*** Sample Question 3.6----------	(4f.1) Provide students with geometric figures with polynomials representing the dimensions. Have students determine area and perimeter. EX:  Perimeter = $2x^2 + 2x + 6$ Area = $(x^2 + 2)(x + 1)$ $= x^3 + x^2 + 2x + 2$ (4f.2) Have students form rectangles of any size with algebra tiles. Then, have students determine the perimeter and area of the rectangles they formed.
Competency 5. **Utilize various formulas in problem-solving situations.** ***Objective—a*** *Evaluate and apply formulas (e.g., circumference, perimeter, area, volume, Pythagorean Theorem, interest, distance, rate, and time).* Sample Question 4.1----------	**(4) Formulas in Problem Solving** (5a.1) Provide students with a copy of "The Formula Chart" from the Mississippi Subject Area Testing Program Teacher's Guide. Allow students opportunities to refer to the chart when solving problems involving specific formulas. (5a.2) Have students design and sketch a floor plan of a house on grid paper. Use appropriate formulas to determine the perimeter and area of each room. (5a.3) Provide students several rectangles with given dimensions and have them determine the length of the diagonals. Also, provide some rectangles with a given width and the length of the diagonal and have students determine the perimeter and area.

Objective—b *Reinforce formulas experimentally to verify solutions.*	(5b.1) Have students discover the approximate value of π by using string and a ruler to measure the circumference and diameter of several circular items. Divide the circumference by the diameter and compare the results. (5b.2) Provide groups of students with a stopwatch and a measuring tape. Have the students mark off a designated distance. Each student will run the distance as someone clocks their time. Use the formula, $d = r \cdot t$ to determine each student's approximate speed.
Objective—c *Given a literal equation, solve for any variable of degree one.* Sample Question 4.2----------	(5c.1) Provide the students with a copy of "The Formula Chart" from the Mississippi SATP Teacher's Guide. Have students choose 10 formulas from the chart and solve them for another variable of degree one.
Objective—d *Using the appropriate formula, determine the length, midpoint, and slope of a segment in a coordinate plane.* Sample Question 4.3----------	(5d.1) Provide students with a pegboard labeled with a coordinate plane and some golf tees. Place 2 tees anywhere on the board. Use appropriate formulas to determine the midpoint and distance between the two tees. Place a tee at the determined midpoint to visually check to see if it appears correct. Use a ruler to measure the approximate distance between the two tees and compare to the answer determined by using the formula. (5d.2) Have students enter programs for specific formulas on a graphing calculator. Students may use the programs to check results when solving problems that involve formulas.

Objective—e *Use formulas (e.g., point-slope and slope-intercept) to write equations of lines.* Sample Question 4.4----------	(5e.1) Provide students with a list of linear equations. Have them write their equivalent forms using slope-intercept, point-slope, and standard forms. Have students choose three x-values. Substitute each x-value into each form of the equation and determine the resulting y-values. The result should be the same for each form.
Competency 6 **Communicate using the language of algebra.** ***Objective—e*** *Use scientific notation to solve problems.* Sample Question 4.5----------	(6e.1) Have students research the distance each planet is from the sun. Have them write each distance in standard and scientific notation. Emphasize that scientific notation is used to express very large and very small numbers in a simpler way. (6e.2) Have students compare standard notations to scientific notations using a graphing calculator. (6e.3) Write numbers in standard form on the board. Use a piece of masking tape that has been rolled into a ball to represent the decimal point. Have students physically move the decimal to the appropriate location needed to write the number in scientific notation. Then, have them write a multiplication symbol and the correct power of ten beside the new number.
	(5)Slope
Competency 7. **Interpret and apply slope as a rate of change.** ***Objective—a*** *Define slope as a rate of change using algebraic and geometric representations.*	(7a.1) Provide students with a graph of several points representing the total cost (y) of a specific number of items (x). Based on the pattern displayed in the graph, determine the total cost of a larger number of items.

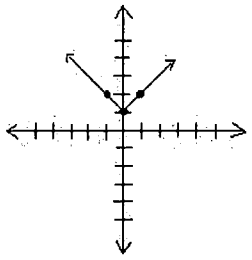
	(7a.2) Provide students with a pegboard labeled with a coordinate plane and some golf tees. Have students begin at a designated point. Read aloud 5 different slopes, one at a time. Students should move their tees to the next appropriate point using the rise/run concept of slope. After all five points have been read, all students should be at the same point (assuming they did not use other equivalent forms of the given slope).
Objective—b Interpret and apply slope as a rate of change in problem-solving situations. Sample Question 5.1----------	(7b.1) Provide students with two equations that represent the cost of two different cell phone plans. Have students graph both equations and interpret the correlation between the slope of each equation and the total cost of the plans.
Objective—c *Use ratio and proportion to solve problems including direct variation(y=kx).* Sample Question 5.2----------	(7c.1) Use the proportion $\frac{Part(is)}{Base(of)} = \frac{rate(\%)}{100}$ to solve basic percent problems. (7c.2) Have students take his/her pulse for 10 seconds. Then, have students write a proportion that could be used to determine the number of times their heart beats in one hour. (7c.3) Have students create a scale drawing of the classroom. Have them show the proportions used to determine the appropriate measurements.
Objective—d *Apply the concept of slope to parallel and perpendicular lines.* Sample Question 5.3----------	(7d.1) Have students graph the equations, $y = 2x$, $y = 2x + 1$, and $y = 2x + 2$ on graph paper and/or on a graphing calculator. Compare and contrast the equations of the graphs. Discuss that all 3 equations have the same slope, but different y-intercepts, therefore they are parallel.

	(7d.2) Have students draw 3 columns labeled parallel, perpendicular, and neither. Write pairs of equations one at a time on the board. Have students place the pairs of equations under the appropriate heading. (7d.3) Use a graphing calculator to explore properties of parallel and perpendicular lines.
Competency 8. **Analyze data and apply concepts of probability.** ***Objective—a*** *Collect, organize, graph, and interpret data sets, draw conclusions, and make predictions from the analysis of data.* Sample Question 6.1----------	**(6) Probability** (8a.1) Have students use the STATS menu of a graphing calculator to determine the mean and median of a set of data. Then, have students graph a scatterplot to represent the data on the calculator. (8a.2) Have students use a graphing calculator to perform a linear regression and find a "line of best fit" for a given set of data. (8a.3) Provide students with a list of numbers. Have them arrange the numbers in ascending or descending order. Have students cross out the top and bottom number on the list and continue this process until either one number is left or all numbers have been crossed out. Discuss that the number left or the average of the last two numbers crossed out is the median of the set of data. (8a.4) Provide students with a number that represents the mean of a set of data. Have students create a set of numbers that would result in the given mean. Emphasize that there could be many answers.

	(8a.5) Given a specific set of data, have students determine whether to graph using a stem-and-leaf, box-and-whisker, scatter plot, line graph or other type of graph. Students should graph the data set, analyze the graph, and explain why they chose a particular type of graph.
Objective—b *Define event and sample spaces and apply to simple probability problems.* Sample Question 6.2----------	(8b.1) Draw a line the length of the board and label one end with the number zero and the other end with the number 1. Provide each student with an index card containing a description of an "event" (e.g., "A baby is a boy.", "The sun will rise today.", "It will snow in July."). Students should place their card along the line according to the probability of that event occurring. EX: event—"A baby is a boy."—This card would be placed in the middle of the line, since the probability is about one-half.
	(8b.2) Have students determine the sample space for the following events: rolling a 6-sided number cube, tossing a coin, tossing 2 coins, and tossing a coin and rolling a number cube.
Objective—c *Use counting techniques, permutations, and combinations to solve probability problems.* Sample Question 6.3----------	(8c.1) Have students use 4 different coins and 4 different colored cups to model the number of different ways the coins could be arranged in the cups. Have students follow-up with a tree diagram to confirm the solution.
	(8c.2) Provide small groups of students with 6 different colored pieces of paper. Have students model combinations if the pieces are used 3 at a time.
	(8c.3) Have students explore combinations and permutations using a graphing calculator.

Samples of Algebra I Test Items

(1.1) The graph represents the function $f(x) = |x| + 1$.



Which of these is the domain of the function?

a) $\{x : x \quad 1\}$
b) $\{x : x \leq 1\}$
c) All Real Numbers *
d) $\{x : -6 \leq x \leq 6\}$

(1.2) Kim drove at a constant rate for 4 hours. After 15 minutes she had driven 16 miles. After 1.5 hours she had driven 96 miles. Which of these is the number of miles she had driven in 4 hours?

a) 192
b) 240
c) 256 *
d) 320

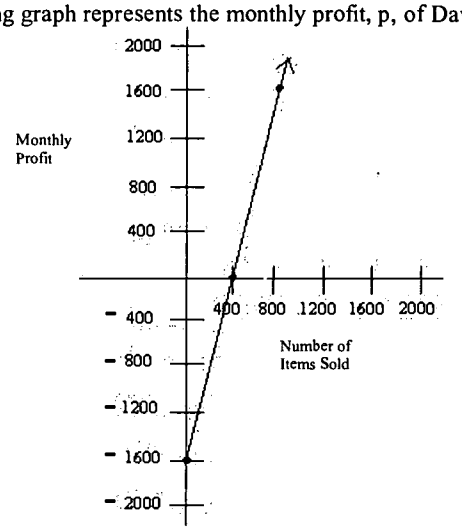
(1.3) The table below contains x and y values that satisfy the equation of a function $y = f(x)$.

x	$f(x)$
2	-4
3	-7/2
4	-3
5	-5/2
6	-2

Which of these equations defines this function?

a) $f(x) = \frac{1}{2}x - 5$ *
b) $f(x) = \frac{1}{2}x + 5$
c) $f(x) = -\frac{1}{2}x + 5$
d) $f(x) = -\frac{1}{2}x - 5$

(1.4) The following graph represents the monthly profit, p, of Dave's Dollar Store.



1) Determine the equation of the line that represents the monthly profit.
2) Use a graphing calculator to determine the monthly profit if 2000 items are sold.

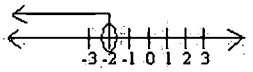
(2.1) Which of these is equivalent to the algebraic expression, $-2(x+y)$?

a) $-2x-2y$ *
b) $-2x+2y$
c) $-2x-y$
d) $-2x+y$

(2.2) Which of these is equivalent to the algebraic expression, $4x+3(x-2)-5x-7$?

a) $7x-13$
b) $2x-9$
c) $2x-13$ *
d) $12x-13$

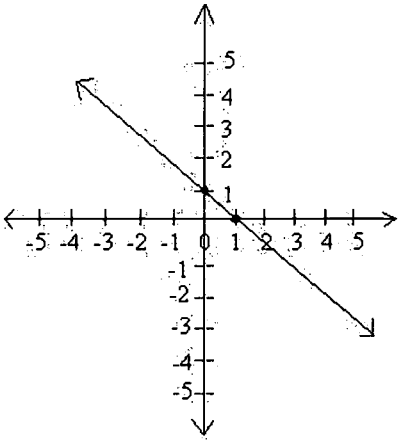
(2.3)



Which of these inequalities has the solution set represented by the graph above?

a) $-5x + 3 < 13$
b) $-5x + 3 > 13$ *
c) $-5x - 3 > 13$
d) $-5x - 3 < 13$

(2.4)



Which of these equations represents the graph shown above?

a) $y = x + 1$
b) $y = x - 1$
c) $y = -x + 1$ *
d) $y = -x - 1$

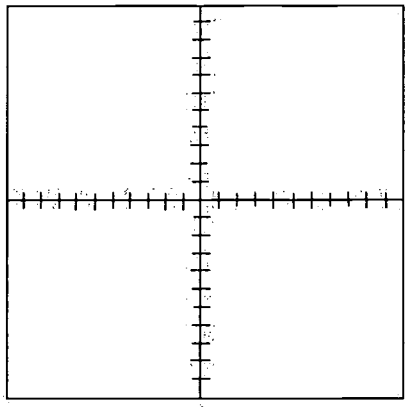
(2.5) Which of these is the solution set for the equation, $|x - 2| = 3$?

a) $\{x : x = 5\}$
b) $\{x : x = -1\}$
c) $\{x : x = 1 or x = -5\}$
d) $\{x : x = 5 or x = -1\}$ *

(2.6) Graph these two equations on a graphing calculator.

$$y_1 = -2x + 10$$
$$y_2 = 3x - 5$$

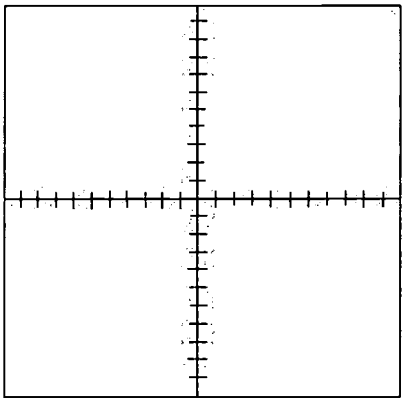
1) On the standard window shown below, carefully sketch the graphs you see displayed on your calculator.



2) Use your calculator to find the point of intersection of the 2 graphs. State the solution as an ordered pair.

3) Determine the equation of a third line that has this intersection point as a solution.

4) Sketch the graph of the new equation on the standard window below.



(2.7) An American Railroad train travels 4 miles less than twice the distance traveled by a Jackson Railroad train. The total distance traveled by both trains is 900 miles. Which of these equations could be used to determine the distance, d, of the American Railroad train?

a) 2d-4=900
b) 3d-4=900 *
c) d-4=900
d) 4-2d=900

(2.8) Which of these equations represents an equation that is linear?

a) $3xy+4=6$
b) $3x^2+y^2=7$
c) $3x+4y=6$ *
d) $y=4x^2$

(2.9) Nancy is x years old today. Which of these algebraic expressions could be used to represent her age 5 years ago?

a) $x-5$ *
b) $5-x$
c) $x+5$
d) $\frac{x}{5}$

(2.10) A = $\begin{bmatrix} -1 & 3 & 7 \\ 2 & 1 & 8 \\ 0 & 4 & 9 \end{bmatrix}$ B = $\begin{bmatrix} 0 & 5 & 10 \\ 15 & 20 & 25 \\ 30 & 35 & 40 \end{bmatrix}$

Which of these matrices represents A+B?

a) *

$\begin{bmatrix} -1 & 8 & 17 \\ 17 & 21 & 33 \\ 30 & 39 & 49 \end{bmatrix}$

b)

$\begin{bmatrix} -1 & -2 & -3 \\ -13 & -19 & -17 \\ -30 & -31 & -31 \end{bmatrix}$

c)

$\begin{bmatrix} -1 & 3 & 7 & 0 & 5 & 10 \\ 2 & 1 & 8 & 15 & 20 & 25 \\ 0 & 4 & 9 & 30 & 35 & 40 \end{bmatrix}$

d)

$\begin{bmatrix} 0 & 15 & 70 \\ 30 & 20 & 200 \\ 0 & 140 & 360 \end{bmatrix}$

(3.1) Which of these is the degree of the polynomial resulting from multiplying $(x+1)(x^2+2x+1)$?

a) 1
b) 2
c) 3 *
d) 4

(3.2) Which of these is the perimeter of an equilateral triangle with a side of length 2x+1?

a) 2x+3
b) 6x+1
c) 6x+3 *
d) 8x+4

(3.3) Which of these are factors of the polynomial $2x^2+9x+4$?

a) (x+8)(x+1)
b) (2x+1)(x+4) *
c) (2x+4)(x+1)
d) (2x+8)(x+1)

(3.4) Which of these is the product of the solutions to the quadratic equation, $5x^2+3x-2=0$?

a) $\frac{2}{5}$
b) $-\frac{2}{5}$ *
c) $-\frac{5}{2}$
d) $\frac{5}{2}$

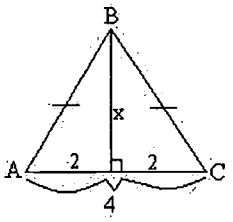
(3.5) Which of these polynomials could NOT represent the area of a rectangle?

a) x^2+2x+1
b) x^2+2x+2 *
c) $4x^2+8x+4$
d) $4x^2-7x-2$

(3.6) Which of these is the area of a rectangle with length (2x+1) and width (x-2)?

a) $3x-1$
b) $6x-2$
c) $2x^2-3x-2$ *
d) $2x^2+3x-2$

(4.1) In isosceles triangle ABC below, the height is x units long and the base is 4 units long.



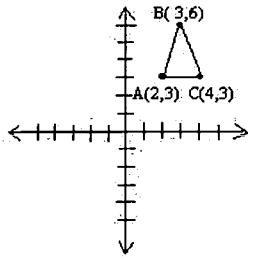
Which of these is the length of $\overline{BC}$?

a) x^2+4
b) $\sqrt{x^2+4}$ *
c) $x+2$
d) $\sqrt{x^2+16}$

(4.2) The formula $A=\frac{bh}{2}$ can be used to find the area of a triangle when the measures of the base and height are known. Which of these is the correct formula for finding the base when the area and the measure of the height are known?

a) $b=2A-h$
b) $b=2Ah$
c) $b=2A+h$
d) $b=\frac{2A}{h}$ *

(4.3) Triangle ABC is sketched on the coordinate plane below.



Which of these is the length of $\overline{BC}$?

a) 2
b) $\sqrt{10}$ *
c) 5.5
d) $\sqrt{130}$

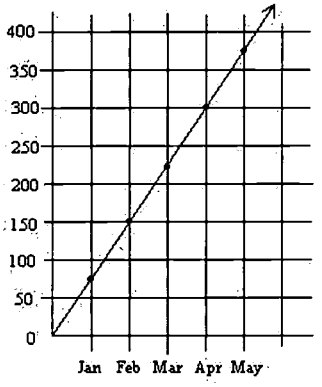
(4.4) Which of these is the result of translating the linear equation $y = -2x + 1$ up 3 units?

a) $y = -2x + 3$
b) $y = -2x + 4$ *
c) $y = \frac{1}{2}x + 3$
d) $y = \frac{1}{2}x + 4$

(4.5) The mass of the Earth is 5,794,000,000,000,000,000,000,000 metric tons. Which of these is this number expressed in scientific notation?

a) $5.794\ 10^{24}$ *
b) $5.794\ 10^{-24}$
c) $.5794\ 10^{24}$
d) $.5794\ 10^{-24}$

(5.1) The graph below represents the amount of money Jessica had in her checking account each month for 5 consecutive months.



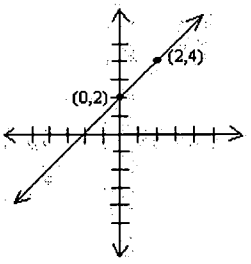
Which of these was the amount deposited to Jessica's account each month?

a) $50
b) $75 *
c) $100
d) $125

(5.2) Mr. Tucker asked his Algebra class to make a scale drawing of the classroom that measured 15 feet by 20 feet. If the shorter side of the scale drawing was 3 inches, which of these would be the length of the longer side of the scale drawing?

a) 4 inches *
b) 5 inches
c) 6 inches
e) 7 inches

(5.3)



Which of these equations represents a line that would be perpendicular to the line shown on the graph above?

a) $y = 2x + 5$
b) $y = -2x + 5$
c) $y = -x + 5$ *
d) $y = x + 5$

(6.1) Wendy scored an 86, 79, 98, 65, 72 and 100 on the six tests given in Algebra I during the first semester. Which of these is the range of her test score?

a) 35 *
b) 82
c) 83
e)165

(6.2) The table below shows the outcomes of tossing 2 number cubes.

1st Number Cube	2nd Number Cube
1	1
1	2
1	3
1	4
1	5
1	6
2	1
2	2
2	3
2	4
2	5
2	6
3	1
3	2
3	3
3	4
3	5
3	6
4	1
4	2
4	3
4	4
4	5
4	6
5	1
5	2
5	3
5	4
5	5
5	6
6	1
6	2
6	3
6	4
6	5
6	6

Which of these is the probability of tossing a sum of 5 on the two number cubes?

a) $\frac{1}{4}$

b) $\frac{1}{6}$

c) $\frac{1}{9}$ *

d) $\frac{1}{12}$

(6.3) Steve and Michelle were playing a board game. In order for Michelle to win, she would need to roll a 4 and a 1 on the two number cubes. Assuming the faces of both number cubes are labeled 1, 2, 3, 4, 5, and 6; which of these would be Michelle's chance of rolling a successful combination?

a) 1 out of 6
b) 1 out of 12
c) 1 out of 18 *
d) 1 out of 36

Section V

Mathematics Teaching and Learning Strategies

The *Mississippi Mathematics 2000 Framework* is comprised of five **content strands: Patterns/Algebraic Thinking, Data Analysis/Prediction, Measurement, Geometric Concepts, and Number Sense** and five **process strands: Problem Solving/Reasoning, Estimating, Incorporating Technology, Communicating, and Making Connections/Applications.** The five interrelated content strands along with the five process strands combine to provide continuity to the teaching of K-12 mathematics. These strands overlap and should be integrated throughout the framework. This continuity provides the necessary foundation for successful completion of high school mathematics requirements. Even though the **process strands** are not listed throughout the framework, these strands **should be incorporated** when presenting the content of the curriculum.

The following multi-step activities incorporate AT LEAST 1 of each of the five process strands.

I. Problem Solving/Reasoning, Incorporating Technology

Materials: unifix cubes or square tiles, graphing calculator

Have Students:

1) Place 1 cube or tile on their desk to represent 1 stair step. Calculate the area and perimeter (assume two dimensions) and record on a data sheet.

2) Add a second stair step and calculate the new area and perimeter and record on a data sheet.

3) Repeat this process until a pattern is discovered.

4) Extend this pattern to 10 stair steps.

5) Create a scatter plot to relate the number of stair steps to the perimeter.

6) Predict the equation that represents this relation.

7) Utilize the graphing calculator to perform a linear regression to verify the accuracy of the equation.

8) Repeat steps #5-7 relating the number of stair steps to the area.

II. Estimating, Communicating, Making Connections/Applications, Incorporating Technology

Materials: Per Group: 2 different size cans, 1 piece of string, 1 graphing calculator, 1 ruler

Have Students:

1) Define a rational number in their own words.
2) Define an irrational number in their own words.
3) Measure the circumference of the cans and round to the nearest hundredth.
4) Measure the diameter of the cans and round to the nearest hundredth.
5) Use the formula, $C = \pi d$ to solve for π.
6) Divide the circumference of each can by its diameter. Round to the nearest tenth.
7) Compare results with other groups.
8) Press the π key on the graphing calculator and compare to the estimated value obtained from actual measurements.
9) Determine whether π is rational or irrational and explain reasoning.

III. Incorporating Technology, Making Connections/Applications, Estimation

Materials: measuring tape, graphing calculator

Have Students:

1) Measure the "wingspan" (finger-tip to finger-tip with arms outstretched) and height of each group member.
2) Complete a list of ordered pairs that relate the wingspan to the height.
3) Sketch a scatter plot on graph paper of the collected data and draw a line of best fit.
4) Use the graphing calculator to create a scatter plot , perform a linear regression, and draw the line of best fit.
5) Predict the heights of other students based on the regression equation.
6) Verify accuracy of predictions by taking actual measurements.

IV. Communicating, Making Connections/Applications, Problem Solving/Reasoning

Have Students:

Solve the following application problems. Show all work and explain processes used to solve each problem. Sketch figures when necessary.

1) The cost of renting a jet ski from Reservoir Ski Rental is $10 per 15 minutes. The cost of renting from Lakeshore Rental is $25 for 30 minutes. Suppose you plan to rent a jet ski for 3.5 hours,

    a) Which is the better deal?
    b) How much would be saved by using the better deal?

2) At Good Deal Grocery Store, a six pack of spring water costs $3.45 and a carton of 4 six packs costs $12.60. How much would you save by purchasing the carton instead of four individual six packs?

3) Jonathan wanted to make a rectangular garden whose width was 2/3 its length. He wanted the garden to cover an area of 150 square feet. What dimensions should the garden be?

4) The Junior Garden Club is holding their annual bake sale. They have determined that the cost, C, to make x dozen cookies can be estimated by the formula, $C = x^2 - 79x + 20$. If they have $100 to spend on making cookies, how many dozen cookies can they afford to make for the bake sale?

5) The area of a rectangle is $x^2 + 5x - 24$. What are the dimensions?

V. Making Connections/Applications, Problem Solving/Reasoning

Materials: String, scotch tape, laminated grid paper

Have Students:

1) Form a square of any size on grid paper, using the string and tape. Cut the string to the exact length needed to form the square. Sketch the outline of the square on the grid paper.

2) Determine the perimeter and area of the square.

3) Cut the string in half and form a second square.

4) Determine the perimeter and area of this square.

5) Repeat this process as many times as possible.

6) Discuss the effect cutting the string in half had on the perimeter and area of subsequent squares.

Process Strands Description:

Problem Solving/Reasoning – Instructional programs from kindergarten through grade 12 should enable all students to—

- Build new mathematical knowledge through problem solving;
- Solve problems that arise in mathematics and in other contexts;
- Apply and adapt a variety of appropriate strategies to solve problems;
- Monitor and reflect on the process of mathematical problem solving;
- Recognize reasoning and proof as fundamental aspects of mathematics;
- Make and investigate mathematical conjectures;
- Develop and evaluate mathematical arguments and proofs;
- Select and use various types of reasoning and methods of proof.

Communicating – Instructional programs from kindergarten through grade 12 should enable all students to—

- Organize and consolidate their mathematical thinking through communication;
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others;
- Analyze and evaluate the mathematical thinking and strategies of others;
- Use the language of mathematics to express mathematical ideas precisely.

Making Connections/Applications - Instructional programs from kindergarten through grade 12 should enable all students to—

- Recognize and use connections among mathematical ideas;
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole;
- Recognize and apply mathematics in contexts outside of mathematics.

Incorporating Technology - Instructional programs from kindergarten through grade 12 should enable all students to—

- Incorporate technology, such as calculators and computer programs, as a tool in conceptual development as well as to promote efficiency in problem solving;
- Advance from the use of simple four-function calculators to complex graphing calculators in problem solving and making applications;
- Utilize on-line Internet resources in relevant mathematics activities and research.

Estimating - Instructional programs from kindergarten through grade 12 should enable all students to—

- Visually estimate length, area, volume, and angle using various referents;
- Develop, apply, and explain a variety of appropriate estimation strategies in problem situations;
- Use estimation to determine the reasonableness of an answer or predict outcomes;
- Recognize when estimation is appropriate and understand the usefulness of an estimate as distinct from an exact answer;
- Recognize the limitations of estimation and assess the amount of error resulting from estimation.

Seven Considerations for a Standards-Based Lesson:

1. Keep in mind the overall goals of the standards:
   - Students will learn to value mathematics.
   - Students will become confident in their ability to do mathematics.
   - Students will become mathematical problem solvers.
   - Students will learn to communicate mathematically.
   - Students will learn to reason mathematically.

2. State Competencies (from the Framework) or updated district curriculum guides should be used to guide what is being taught. Be aware that several of the competencies can be combined into one lesson or set of lessons. Some competencies will be included in many activities throughout the year.

3. Consider/define the desired result for the end of the lesson (or set of lessons). In other words, what will the assessment for this lesson look like? What will you be expecting students to know and do?

4. Select tasks and activities to guide students toward understanding and doing the mathematics desired. The tasks selected should:
   - engage students' interest and intellect;
   - develop students' mathematical understanding and skills;
   - allow students to connect their learning with previous learnings;
   - call for problem formulation, problem solving, and mathematical reasoning; and
   - promote communication about mathematics.

5. Use your Framework, textbook, and other resources for possible activities. Look at each activity proposed by the textbook or resource and ask:
   - Does the activity fit with the objectives?
   - What is the purpose of the activity? Is it introducing an idea, developing a concept further, or extending to a new idea?
   - Is the activity engaging? Is the student interested in participating in the activity or solving the problem?
   - Is the activity active? Does it use manipulatives or materials? Is it cooperative?
   - Is the activity concrete, pictorial, or abstract?
   - What learning styles does the activity make use of?
   - Does the activity allow the student to connect to previously learned ideas?
   - What are the thinking levels addressed by this activity? Can the activity be adapted to address various levels of thinking?
   - Does the activity provide opportunities for the student to communicate about mathematics (orally or in writing)?

6. Arrange the available activities to develop the mathematical idea from concrete to abstract (remember this process may require several days). The activities should address all levels of thinking: recall, comprehension, application, analysis, synthesis, and evaluation.

7. Examine the lesson in relation to your original intent (the assessment from step 3).

Mathematics and Writing - Making the Connection

"Good writing is a reflection of clear thinking, and clear thinking rather than memorization is the key to success in mathematics."

Melvin Henriksen
Harvey Mudd College
Claremont, California

Classroom Writing Exercises - Long and Short:

- Writing Journals/Math Logs
- Writing Problems
- Writing Solutions
- Writing Explanations
- Writing Observations
- Writing Reports
- Writing Error Analyses
- Writing About a Concept
- Writing to Create

Use writing exercises as -

- Group activities;
- Parts of tests or quizzes;
- Long term assignments to clarify difficult procedures or procedures that are subject to common mistakes;
- Prelude to oral reports; and
- Opportunities for student creativity.

Writing activities promote -

- Connections between and among mathematics and other disciplines;
- Divergent thinking;
- Group participation;
- Increased understanding of mathematics terminology; and
- A better grasp of concepts.

Writing in Algebra - Suggested Prompts

What is an irrational number? Explain in your own words.

What is a real number? Explain in your own words.

What is the difference between commutativity and associativity ? Explain in your own words and try to give some nonmathematical examples.

What is the transitive property of equality? Are some relationships that do not involve numbers transitive? For example, is the cousin relationship transitive? Discuss and explain in your own words.

Why do we invert and multiply to divide fractions? Explain in your own words.

Why are we not permitted to divide by zero? Give two or three examples and explain in your own words.

What happens when you divide a whole number greater than one by a positive fraction less than one? Give two or three examples and explain in your own words.

Write a small negative number and explain why it is small. Then write a large negative number and explain why it is large.

Why does $3^0 = 1$? Explain in your own words.

Why does $12 - (-3) = 15$? Explain in your own words.

Why does $(-4)(-5) = 20$? Explain in your own words.

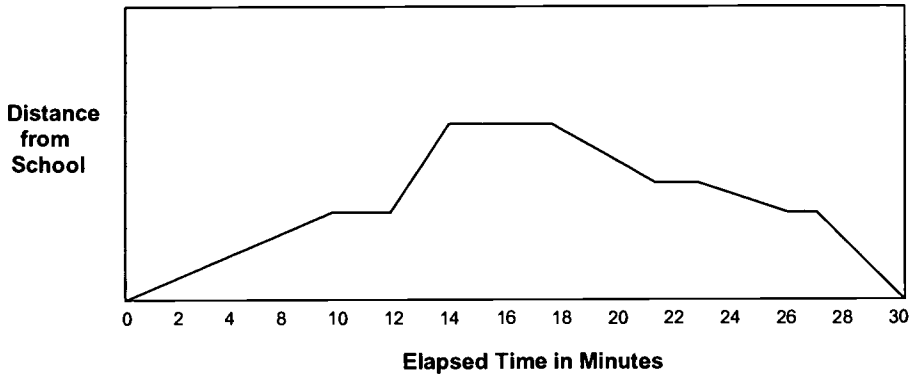
What is the meaning of the phrase "the slope of a line"?

Write a letter to a celebrity (you choose) and explain why one of the following statements is true.

- $2^{-1} = 1/2$
- $(x + 1)^2$ is not equal to $x^2 + 1$
- When you double the radius of a circle, the area is *not* doubled.
- When you double the length and the width of a rectangle, the area is *not* doubled.
- When you multiply two negative numbers together, you get a positive number.
- In the equation $y = \frac{1}{x - 2}$, x cannot equal 2.
- The whole numbers 1, 4, 9, 16, 25, etc. are called perfect squares.
- The whole numbers 1, 8, 27, 81, 125, etc. are called perfect cubes.

Writing About Graphs

Jamie left his algebra project at home, so he rode his bicycle from school to his house. He got the project and rode back to school. He left school at 8:15 a.m. and returned to school at 8:45 a.m. on the same day. The graph below shows the relationship between the elapsed time and Jamie's distance from the school during the trip. Write a paragraph about Jamie's trip from school to home and back.



Sample Journal Prompts

1. All Roman numerals are numbers. All numbers are not Roman numerals. Explain your reasoning.

2. The set of Real Numbers is like a family. Which members (subsets) of the Real Number family would you use to represent the children, parents, grandparents, etc. Explain your reasoning.

3. Write a paragraph to explain the difference between "a factor" and "to factor".

4. Two students worked the same problem and got the same answer. Their work is shown below.

Student 1

$$(3^{-1} + 2^{-2})^{-1} = (3^1 + 2^2)$$
$$= (3 + 4)$$
$$= 7$$

Student 2

$$(3^{-1} + 2^{-2})^{-1} = \frac{1}{(3^{-1} + 2^{-2})^1}$$
$$= (3^1 + 2^2)$$
$$= 3 + 4$$
$$= 7$$

Did either student work the problem correctly? Explain your reasoning.

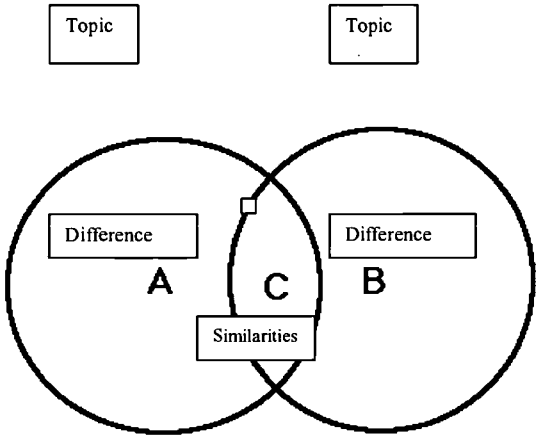
Graphic Organizers

The Venn Diagram

The Venn diagram is one of the most often used tools to assist students in visualizing comparisons and contrasts. The information gathered and written on the diagram provides the basis for clear organization of thought and translation of information into writing.
Use a Venn diagram whenever there is an opportunity to compare and contrast.

To use the diagram:
1. Put names of two topics to be compared in the boxes above the circles.
2. Identify the similarities between the two topics. List these where the two circles overlap each other. "C"
3. Identify the differences between the two topics. List the differences of the first topic in the circle to the left "A". List the differences of the second topic in the circle to the right "B".
4. Analyze the similarities and differences.

Encourage students to look for other opportunities to apply this valuable graphic organizer.



Mapping and Clustering

Mapping, or clustering, can be used to elaborate on a central idea or topic. Information and details are clustered around a central idea or topic. This helps students organize ideas and promotes improved fluency in writing or other forms of expression when communicating about a topic. Mapping or clustering can be approached in a number of ways.

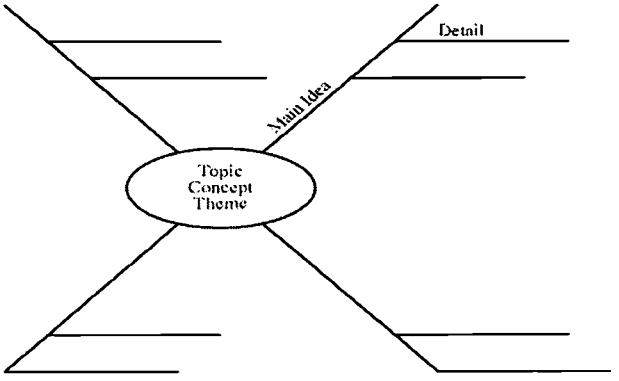
Brain storming - Mapping or clustering can begin with brainstorming, a technique that has students express randomly a variety of ideas, thoughts, opinions, and viewpoints about the given topic.

1. Record the topic in the center of a transparency.
2. Gather ideas into cluster around the central topic.
3. Discuss students' associations with the topic.

This technique works effectively to introduce students to new topics since it can require students to consider how their personal experiences are connected to the new topic.
Research shows that a student retains information better when it is connected to the personal experiences or prior knowledge of the student. As such, this technique has been shown to be especially effective with Limited English Proficiency (LEP) students and low achievers.

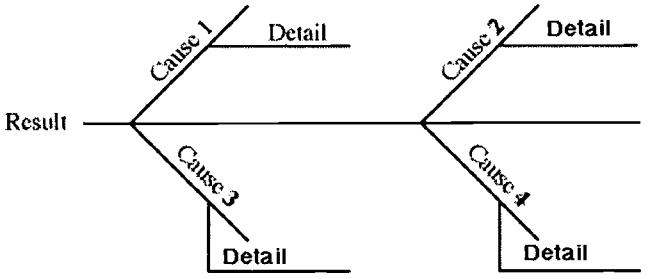
Basic instructions for mapping or clustering:
1. Place a main topic in the center.
2. Place each subtopic on a line that branches out from the main topic.
3. Place supporting details off from each appropriate subtopic.

Different forms of mapping and clustering are presented below.
Spider map: is used to describe a central idea, a process, a concept, or a proposition.

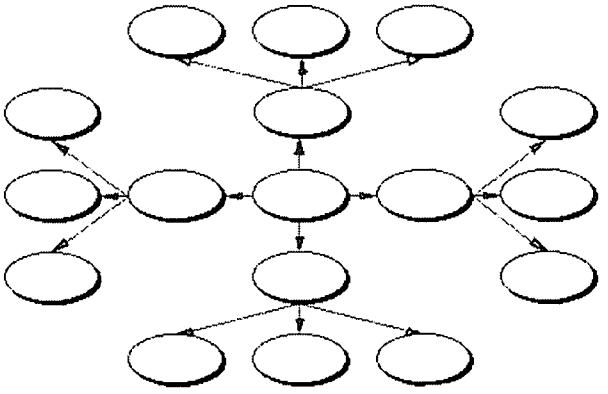


The key frame questions for spider mapping are: What is the central idea? What are its attributes? What are its functions?

Another form of mapping is **Fishbone mapping**. A Fishbone map is used to show the causal interaction of a complex event (an election, the census) or a complex phenomenon (inflation, mathematics anxiety).
The frame questions for this form of mapping are: What are the factors that cause X?
How do they interrelate? Are the factors that cause X the same as those that cause X to persist?



Clustering is a nonlinear activity that generates ideas, images and feelings around a stimulus word. As students cluster, their thoughts tumble out, enlarging their word bank for writing and often enabling them to see patterns in their ideas. Clustering may be done as a class or as an individual activity.



Appendices

Glossary of Terms

Alternative Assessment – any type of assessment in which students create a response to a question, as opposed to assessments in which students choose a response from a given list, such as multiple-choice, true/false, or matching. Alternative assessment can include short answer questions, essays, performance assessments, oral presentations, exhibitions, demonstrations, and portfolios.

Analytical Trait Scoring- a performance is judged several times along several different important dimensions or traits of the performance. Use of a scoring rubric and anchor paper for each trait is common. An example might be judging of student problem solving for understanding the problem, correct use of procedures and strategies, and the ability to communicate clearly what was done.

Anchor papers or benchmark performances – examples of performances that serve as a standard against which other papers or performances may be judged; often used as examples of performances at different levels on a scoring rubric.

Assessment Strand – Competencies used for test construction purposes are combined for reporting purposes into assessment strands. The test items are written to the competencies, not the assessment strands.

Authentic (assessment) – assessment tasks that elicit demonstrations of knowledge and skills in ways that resemble "real life" as closely as possible, engage students in the activity, and reflect sound instructional practices.

Benchmarks- Statements of what students should know and do by certain grade levels or times.

Benchmark performance – see "anchor papers".

Blueprint – The blueprint indicates the number of items from each assessment strand that must appear on a test.

Competency/Item match- There must be alignment between a given competency and an item that measures the competency.

Context (of an alternative assessment) – the surrounding circumstances within which the assessment is embedded. For example, problem solving can be assessed in the context of a specific subject (for example social studies) or in the context of real-life laboratory problems requiring the use of mathematical, scientific, social studies, and communication skills and tools.

Constructed Response – is a type of free response or open ended question; more than one right answer is possible; scored using a rubric and scoring guide.

Core items – This term refers to the body of scorable test items that count toward the student scores.

Criterion referenced test (CRT)- CRTs are constructed to assess a student's understanding of given competencies or objectives. The Mississippi subject area tests are criterion – referenced.

Distractors- The incorrect answers to a multiple-choice item are called distractors.

Enhanced multiple-choice – a question which elicits the use of a students prior knowledge, integrates knowledge and process skills and uses an "enhancement" (e.g., map, chart, graph, speech excerpt, etc.).

Evaluation – a judgement regarding the quality or worth of the assessment results. Evaluations are usually based on multiple sources of assessment information. For example, "The information we collected indicates that students are performing above expectations".

Field – test items – Field –test items have never been on a test before. These items have no statistical data and are not counted for or against the students score. Once these items have been tested and statistically evaluated, they may appear on new forms of the test, or they may be deleted. Field test items are not identified on the test so that students will not know which items count and which do not.

Item- This term refers to a single question or problem in a test.

Multiple-choice items- Multiple choice items ask students to choose the correct or best answer from several given answers or options. Mississippi SATP items are both multiple choice and open ended.

Objective- This term refers to the knowledge, skill, process, or strategy that an item measures.

Options – This term refers to the possible responses in multiple –choice items, including the correct response and all distractors.

Selected response item- This is another term for a multiple – choice item.

Standardized test- This term refers to a test that contains the same content administered in the same way for everyone taking the test.

Stem- The item stem actually states the problem. This can be posed as a question or as an incomplete statement.

Stimulus- The item stem, piece of art, or referent that prompts a response is called a stimulus.

Test construction- This term encompasses selecting the items that go into each form of a test and then arranging them in an appropriate sequence.

Recommended Internet Resources

Mississippi Department of Education Mathematics Page
http://www.mde.k12.ms.us/acad/id/curriculum/Math
Links to the *Mississippi Mathematics 2000 Framework*, the *Mathematics Instructional Intervention Supplement*, the Subject Area Testing Program including the Algebra I Practice Test, conferences and other mathematics events, mathematics resources including Internet resources, and other information related to mathematics can be found at this site.

Principles and Standards for School Mathematics
http://www.standards.nctm.org
Download the newly revised national standards at this site. Here you will also find electronic examples including interactive activities that support Principles and Standards.

National Council of Teachers of Mathematics
http://www.nctm.org
Grades K-12. This site provides updates on publications, meetings, and links to related mathematics education sites.

Mrs. Lindquist: The Tutor
http://www.algebratutor.org/
This free site provides tutoring for students in writing expressions for algebra word problems.

Texas Education Agency
http://www.tea.state.tx.us/
This site provides released and online Algebra I end-of-course exams similar to our Mississippi Algebra I Test.

Math.com
http://www.math.com
A free site providing math help for students, parents, and teachers. It includes homework help, games and puzzles, math practice and test preparation, on-line calculators, and more.

MathNerds
http://www.mathnerds.com
MathNerds provides free, discovery-based, mathematical guidance via an international, volunteer network of mathematicians. MathNerds does not supply answers to homework, take home tests and the like; rather, they provide hints, suggestions, and references to help clients understand and solve their mathematical problems.

Algebra in the Real World
http://www.thefutureschannel.com/algebra
A resource kit for teaching and staff development, *Algebra in the Real World* will enable you to show your students the excitement, the power, the range and the results of the application of algebra in sixteen fascinating career fields.

The Math Forum
http://forum.swarthmore.edu
This project is an outgrowth of the Geometry Forum project which established an electronic community where all interested in geometry could turn to find colleagues and resources on the Internet, from kindergarten to college, and venturing into other areas of mathematics. Expanded activities included: Internet workshops for teachers, summaries of math education research published on the newsgroups, school networking support, Ask Dr. Math, the Elementary Problem of the Week, project archives and Internet mathematics resource indexes, web-based lessons and classroom materials.

Figure This! Math Challenges for Families
http://www.figurethis.org
This site includes challenging problems for students and their families to solve along with hints and multiple solutions. It also includes a Family Corner with math resources for parents and advice on how they can help their children be successful in and get the most out of mathematics.

Math Is Power
http://www.mathispower.com
This is the secondary sister site to Figure This! and includes algebra, geometry, and calculus challenges in an exciting arcade style format. The Math Is Power and Figure This! campaigns are designed to: Empower students and families to demand access to quality mathematics instruction; encourage greater family involvement in education, both in and out of school; demonstrate what high quality middle school mathematics looks like; equip families with the information needed to help their children and dialogue with teachers; and emphasize the importance of high quality math education for all students.

Math Education: Problem of the Week
http://pegasus.cc.ucf.edu/~mathed/problem.html
Each week a new mathematical problem is posted. Students are encouraged to provide a solution. Each correct solution for the week will be entered in the weekly drawing for a CASIO FX-280 Solar, Scientific Calculator.

Texas Instruments
http://www.education.ti.com/
This site provides the latest information on calculator resources, activities, online algebra resources, and professional development opportunities.

PBS Teacherline
http://www.pbs.org/teacherline
TeacherLine is an innovative model of online professional development, currently offered through PBS member stations. Facilitated modules, informal learning opportunities, and certificate programs focus initially on two high-priority areas in teacher professional development— mathematics and the integration of technology into classroom practice.

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

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